Design Engineering

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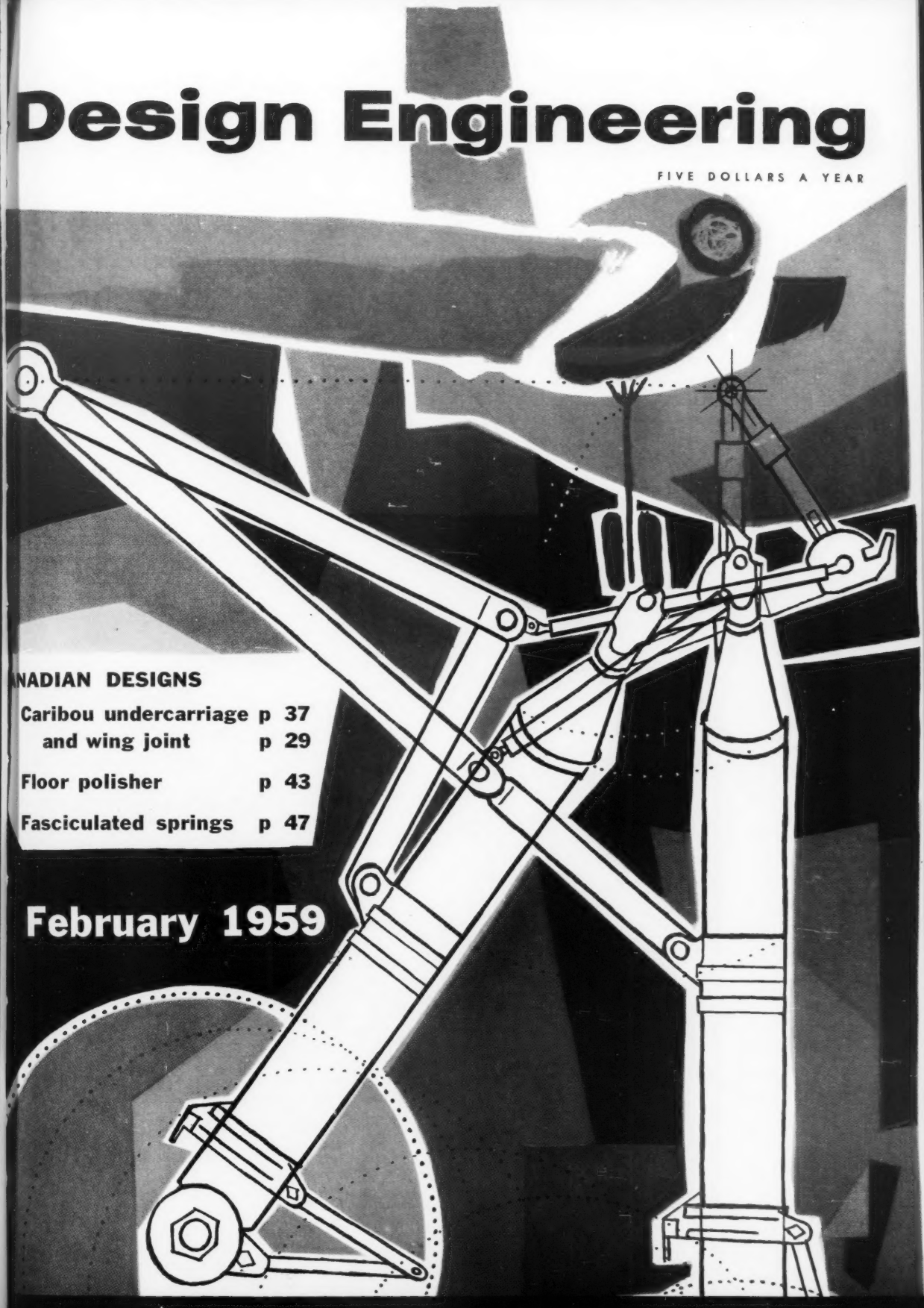

NADIAN DESIGNS

Caribou undercarriage and wing joint p 37 p 29

Floor polisher p 43

Fasciculated springs p 47

February 1959

PUBLISHED BY THE MACLEAN-HUNTER PUBLISHING COMPANY LIMITED, TORONTO, CANADA

RCI EPOTUF Epoxy Resin

"An ideal resin for potting applications"

says J. R. McRobert, vice president, Novi Equipment Company

Engine heat, vibration and road shocks present problems that must be met and mastered in auto air conditioning equipment. And the Novi Equipment Company, Novi, Michigan, has found that an RCI EPOTUF epoxy resin plays a vital role in the manufacture of its air conditioners — successfully seals a copper coil component in the steel magnetic compressor clutch — insuring dependable performance.

"The use of EPOTUF allows a very close tolerance with a permanent, rigid seal that prevents copper-steel contact — and the 'shorting out' that would thereby result," explains Mr. McRobert. "EPOTUF is the ideal resin for our purposes, possessing excellent qualities of adhesion with the exact electrical properties we require."

Manufacturers everywhere are finding increased use for Reichhold's versatile epoxy resins. EPOTUF epoxies offer rugged strength, corrosion resistance and superior bonding properties that have proven perfect for a variety of applications.

And when you do business with RCI, you can count on fast, on-time deliveries anywhere in the country. Why not let *us* know *your* epoxy requirements?

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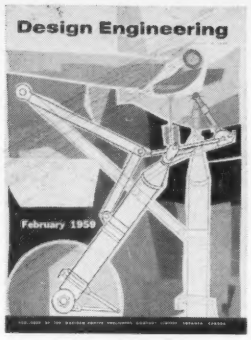

Design Engineering

Vol. 5 **FEBRUARY 1959** No. 2

This month's cover

"Let's get a really different cover for February—after all it's featuring some top Canadian designs." So said Editor Bill Morse aeons before Lunik. Gentlemen, you have a truly different cover. Frank Newfeld played the camel hair brushes on an undercarriage theme by Caribou. It has caused eyebrows to shoot up . . . generated flowery praise. In the midst of it all, originator Morse is still not sure whether he likes it.

Design Engineering

MEMBER

CCAB

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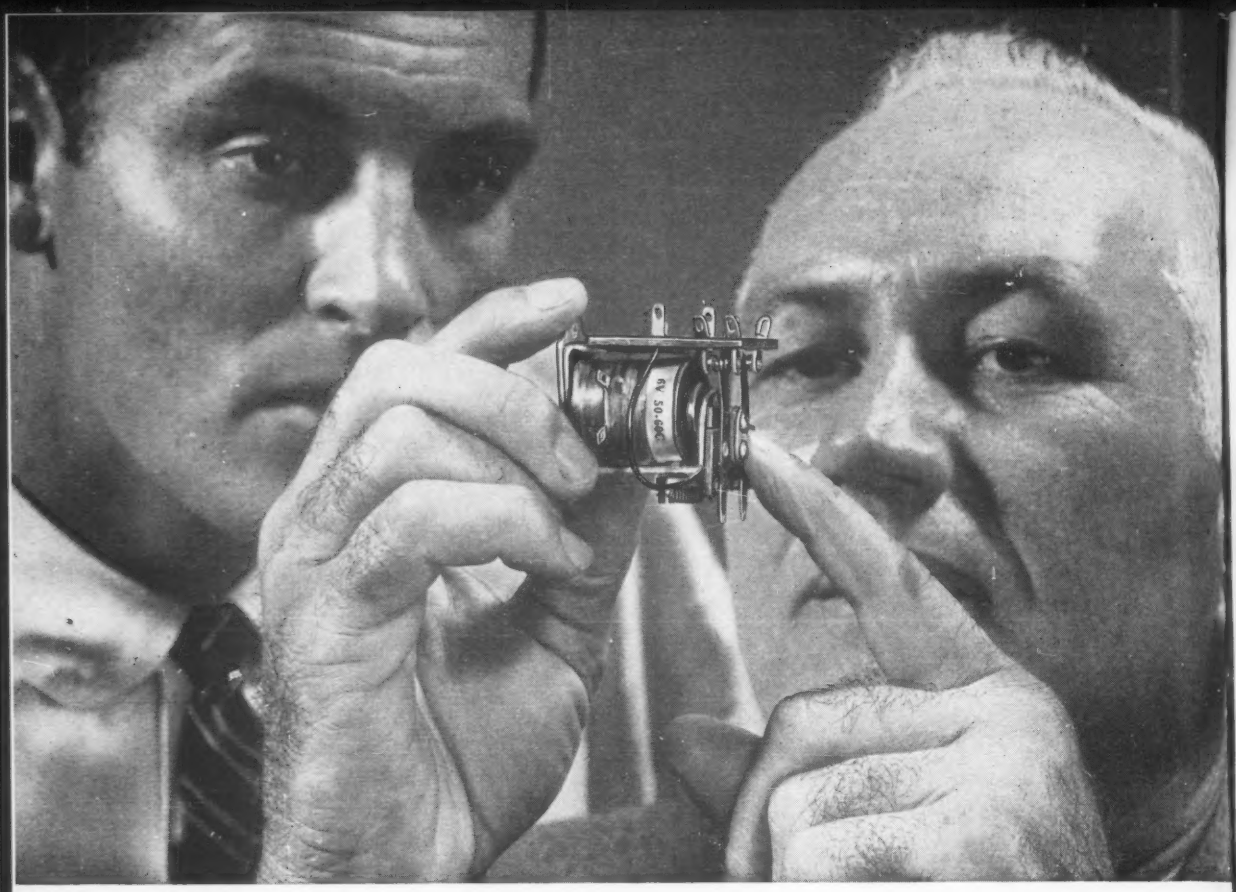


NOW AVAILABLE IN CANADA... KL... A VERSATILE, RELIABLE, LOW COST P & B RELAY

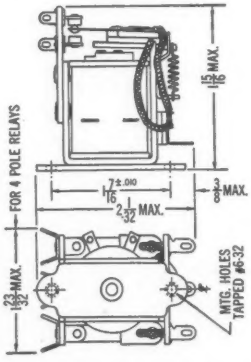
for communications and automation

ECONOMY and versatility distinguish our KL series relays. Contact arrangements are available up to 4 pdt in either AC or DC versions. Sensitivity of 100 milliwatts per movable arm is available.

Stationary contacts and terminals are mounted on a phenolic front of high dielectric strength, thus adding to the utility of the relay. Conveniently located terminals and easy-to-mount base greatly simplify installation on long production runs.

KL relays may be hermetically sealed or furnished in metal dust covers.

This is one of a "family" of fine P&B relays. Others, with similar configurations but various electrical and switching capacities, are shown below. Write or call for more information or see the complete P&B catalog in Sweet's Product Design File.



KL ENGINEERING DATA

GENERAL: Breakdown Voltage: 500 volt rms, 60 cycle between all elements standard 4 pole relay; 1500 volts rms, 60 cycle on special 3 pdt relay.

Temperature Range: −45°C. to +85°C.

Pull-in: Approx. 75% of nominal dc voltage.
Approx. 78% of nominal ac voltage.

Terminals: Pierced solder lugs for two #20 AWG wires.

Enclosures: Metal can 2⅝" high x 2⅞" long x 2½" wide with octal plug or multiple solder header.

CONTACTS: Arrangements: up to 4 pdt.

Material: ⅛" dia. gold-flashed silver. (Others available.)

Load: 5 amps @ 115 volts, 60 cycle resistive loads.

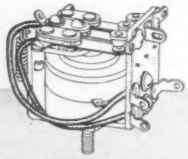
COILS: Resistance: 60,500 ohms max.

Power: 100 milliwatts per movable arm.

Duty: Continuous; coils will withstand 6 watts @ 25°C.

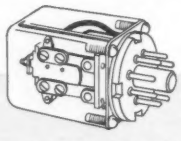
Voltages: up to 110 volts dc.
up to 230 volts ac.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR



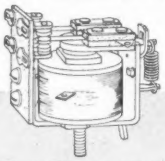
KR SERIES: SMALL, 5 AMP RELAY

Ruggedly constructed for long life and dependability. Available up to 3 pdt.



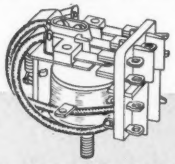
KCP SERIES: SENSITIVE 3 PDT RELAY

For plate circuit applications requiring low cost, sensitive relay. Polyethylene dust cover.



KT SERIES: ANTENNA RELAY

Insulated to minimize RF losses. Designed to switch 500 watts RF input to 300 ohm line.



KA SERIES: GENERAL PURPOSE

Compact, light-duty relay. U/L approved. Meets 1500 volts rms breakdown requirement.

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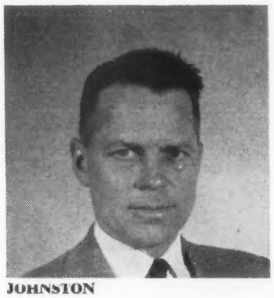
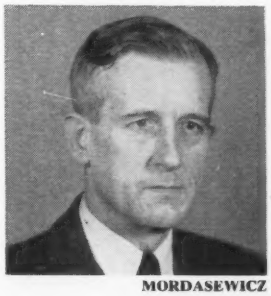


JOHNSTON

J. S. Johnston gave us a real thumb-nail sketch of himself for the authors' page. But we can tell you that he graduated from Queens University in mechanical engineering and chalked up overseas service with the RCAF. We also know that he is a member of APEO, the Society for Experimental Stress Analysis — and likes sailing on Georgian Bay, curling and hi-fi. And that, we discover, just about fills our space up.



MORDASEWICZ

We don't know Stan Mordasewicz' hobby — but we do know he's no stick-in-the-mud. Born in Poland, he shuttled between Warsaw and Paris to get civil and mechanical engineering degrees. Then he worked for Unic, Panhard, Stetysz and Hotchkiss of France; Fiat and GM of Poland; Saurer of Switzerland; Ford and GM in the U. S. But he seems to prefer Canada where he has been with the Dept. of Defence since 1946.

In September 1955 Michael Davy wrote about the Otter wing for DE. Now he discusses the Caribou wing. Wings are quite a concern with this graduate of London University: he wore a pair on his tunic as a wartime RAF pilot. Without risk of eulogy, we'd say Davy is pretty well up on wings. Three young daughters keep him grounded, but on the other hand are angelic (if wingless) subjects for his beloved camera.

DAVY

An article on submerged arc welding by Stephan Gyurik appeared in the March 1955 issue of DE. Like two of our other authors, he is from Europe. At 21, he graduated from the National Engineering School in Paris (mon dieu, what fortitude!), and a year later he acquired an aeronautical engineering degree. He served in the French navy from 1949 to 1951 and then came to Canada. He is with Jarry Hydraulics, Montreal.

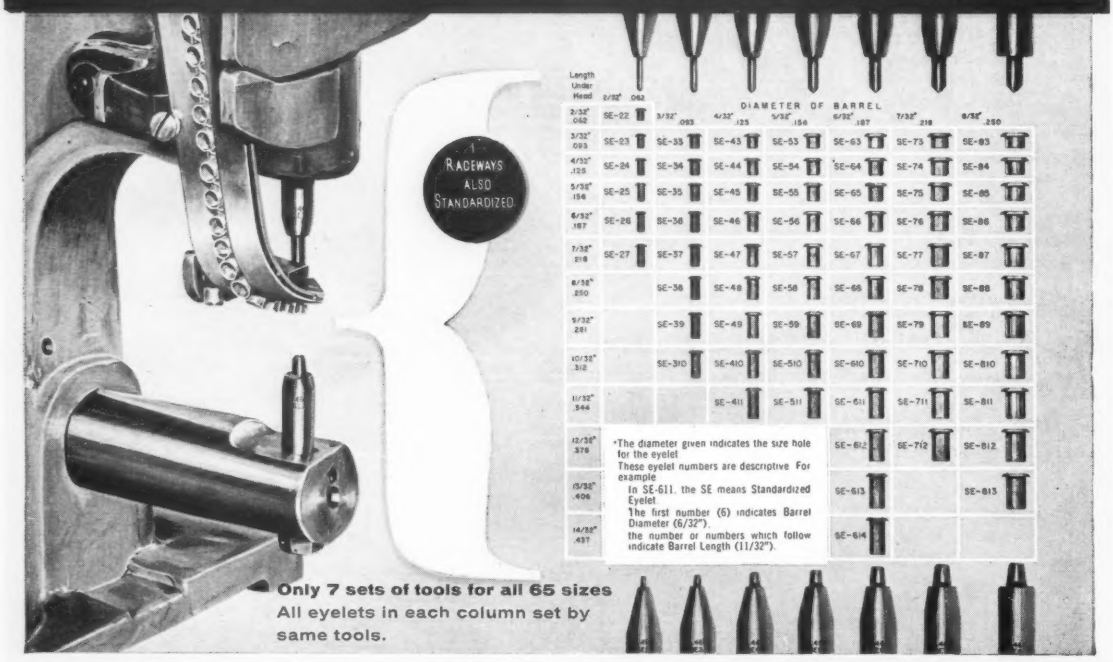
GYURIK

STOP the EYELET HUNT

Simplify design
Speed production
Save money

You can save many expensive engineering hours because designers no longer need to plow through thousands of eyelet specifications. Over 20 years' experience has shown that a very high percentage of all eyelet work can be done with the 7 United Standard diameters.

Use UNITED Standardized Sizes



Length Under Head	DIAMETER OF BARREL 2/32" .062	3/32" .093	4/32" .125	5/32" .156	6/32" .187	7/32" .218	8/32" .250
2/32" .062	SE-22						
3/32" .093	SE-23	SE-33	SE-43	SE-53	SE-63	SE-73	SE-83
4/32" .125	SE-24	SE-34	SE-44	SE-54	SE-64	SE-74	SE-84
5/32" .156	SE-25	SE-35	SE-45	SE-55	SE-65	SE-75	SE-85
6/32" .187	SE-26	SE-36	SE-46	SE-56	SE-66	SE-76	SE-86
7/32" .218	SE-27	SE-37	SE-47	SE-57	SE-67	SE-77	SE-87
8/32" .250		SE-38	SE-48	SE-58	SE-68	SE-78	SE-88
9/32" .281		SE-39	SE-49	SE-59	SE-69	SE-79	SE-89
10/32" .312		SE-310	SE-410	SE-510	SE-610	SE-710	SE-810
11/32" .344			SE-411	SE-511	SE-611	SE-711	SE-811
12/32" .375					SE-612	SE-712	SE-812
13/32" .406					SE-613		SE-813
14/32" .437					SE-614		

*The diameter given indicates the size hole for the eyelet.
These eyelet numbers are descriptive. For example
In SE-611, the SE means Standardized Eyelet.
The first number (6) indicates Barrel Diameter (6/32").
the number or numbers which follow indicate Barrel Length (11/32").

Only *SEVEN* sets of tools needed for all 65 sizes! This means that tooling is reduced as much as 90%. With United's closely co-ordinated system of Standardized Eyelets and Eyeleting machines, eyelet grip can be increased as much as 1000% (for instance, from .093″ to .437″) without a single change in drill, punch, or setting tool. Result: greatly reduced installed costs and true fastener economy.

Purchasing problems are eliminated. United Standardized Eyelets are carried in stock at key points:

Low eyelet costs for you are ensured by United's constant high volume production on a relatively small number of sizes.

Inventory is greatly simplified. Fewer sizes do more jobs. Actual experience of thousands of users for over two decades has shown that United Standardized Eyelets and co-ordinated Eyeleting machines can reduce the number of eyelet sizes carried in stock an average of 66⅔%.

Precision made in standard increments of 1/32″ in both barrel O.D. and length, each one of the 65 United Standardized Eyelet sizes has a standard relationship in dimension and proportion to every other eyelet in the series. They are designed to save you money. Start to-day to enjoy the advantages of United's Standardized Eyelets. Write or call us for complete information.

New Eyelet Catalog Complete specifications of all phases of United's co-ordinated system of eyelets, eyeleting machines, setting tools. Also includes data on special eyelets and metal stampings.

United

SHOE MACHINERY COMPANY OF CANADA LIMITED

UNITED **Industrial Sales Division**

MONTREAL TORONTO GALT QUEBEC

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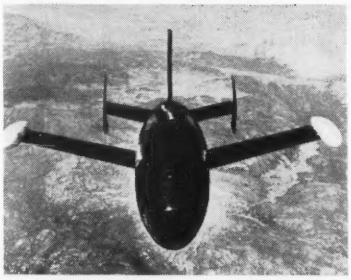
Reports

A news roundup of items of engineering and design interest from the world over

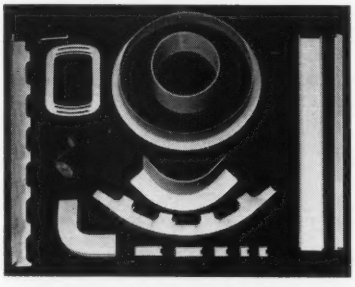
Who said engineers in San Diego don't work?



Take heart from this story if you're fighting a battle of costs. Down in sun-soaked San Diego an aircraft firm got an order to produce molded fibre glass shells for wing tip radomes on a drone target. But they had to do it on a tight production schedule.

Aluminum castings and patterns would cost $600 and delivery couldn't be promised in less than six weeks. Stalemate? No sir—the company engineers rolled up their sleeves and started to build a male mold out of scrap pieces of cast aluminum tooling metal, bonded together with a structural aircraft adhesive. Result: the job was done on time and the company (Ryan Aircraft) expect to save $20,000 annually with similar techniques.

Some firms can now wave goodbye to tooling costs



Yes, it could be a do-it-yourself kit for making portable holes, or even the fulcrum point for an abstract painting. But the photograph actually shows electrical pressboard components for a transformer board.

Interested to know more, we called Mr. T. C. Drees vp of Spaulding Fibre of Canada, manufacturers of the pressboard. "What we do," he said, "is to make finished parts for assembly rather than sell the sheet material. We are tooled up to service circuit breaker, switch gear, wiring device and appliance industries," he went on. "In fact we have a catalogue range of items like radial spacers in 400 different sizes." We asked him about cost. "It's generally cheaper than buying pressboard the old way." Which is good news to report.

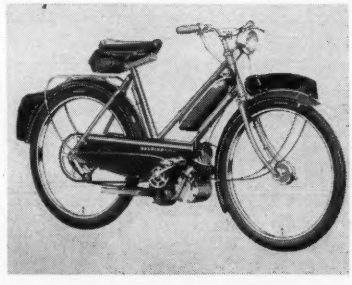
A call from Caracas brought the boss out in smiles

"We are sometimes amazed at the telephone calls we get from far away places like California and Central America. Many of them are to buy our equipment on reputation alone."

That's what Mr. Bruce Wilson told us when we talked with him about the continued success of the centrifugal automatic clutch he brought out in 1931. Since then it has acquired refinements and has taken on extremely rugged duties like dredge work at Steep Rock Lake and Caland Iron Mines and the St. Lawrence Seaway.

"An interesting sidelight on the BLM clutches," Mr. Wilson (shown at right in photo) went on, "is that we still get the occasional call for a CC-44 clutch. It's the first one we ever made."

Nothing like a new bike to evoke Constable



Just about now when we look at the dippy thermometer we start getting pipe dreams. In them we dawdle along leafy country lanes, watch sleepy cows and snuffling hogs — and for excitement a hawk might plummet out of an azure sky.

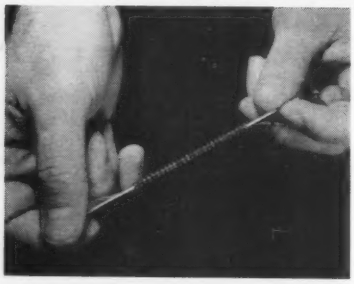
We were reminded of this pastoral scene the other day when we saw photographs of a moped built by Raleigh Industries of England. It's a bicycle equipped with a 49 cc two-stroke engine that translates one gallon of gas into 170 penny-pinching miles. We were light-hearted to think that someone was looking after our spirits as well as our pocket — and we called Raleigh right away. "The idea of bike transportation in Canada is new . . . but we hope to sell lots of them." We hope they do, being chumps for thinking that getting there should be half the fun.

An idea for patching honeycomb panels in the field

What should you do when there are field repairs to be carried out on damaged honeycomb panels? One firm we heard about had this problem more than once—because they tackled it pretty thoroughly and came up with a practical answer.

It combines a self-sealing vacuum diaphragm, a vacuum aspirator and a heat source in a single molded rubber unit. To repair a panel on a field airplane say, a fibre glass patch is used in place of aluminum honeycomb and skin. The tool shown in the photograph will apply a six-inch patch—and has a temperature range of 100 to 350 deg F. A model now being designed by Boeing Airplane Co. will include controls in the rubber unit, aiding versatility.

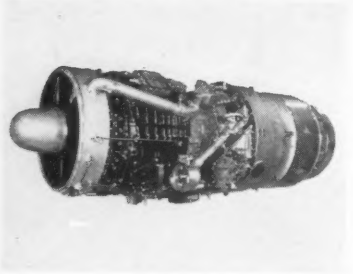
Another of those twisted wire stories



We thought it was a photograph of a man refilling his empty ballpoint pen. Instead, the refill turned out to be a reversible diodeless shift register employing a single magnetic wire as the memory element.

In the experimental shift register, information "bits" are written in and slid along by means of tiny eight-turn solenoids, each 0.075 in. long and spaced the same distance apart. The coils are wound on a ceramic tube and the magnetic wire (0.002 in. diameter permalloy) is stretched through centre of the tube. So far, tests allow storage of three bits per inch, but the predicted capacity is more likely to be ten bits per inch. Bell Telephone Laboratories have been doing all the work.

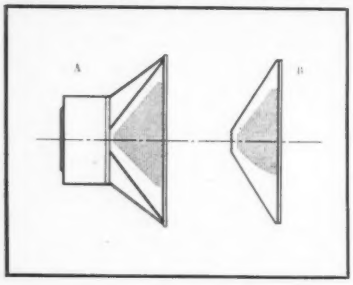
A trumpet fanfare for whispering horsepower



Not a remarkable picture—but certainly a remarkable power unit. Do you recognize it? For your information it's the Rolls-Royce RA-29, a unit of 10,500 lbs thrust used in the Comet 4 and the Sud Aviation Caravelle.

An impressive piece of engineering, it represents the ultimate in the second generation axial turbo-jets: which means it hasn't yet reached its peak thrust. It has another claim to fame too. The Air Registration Board of Great Britain gave it a 1,000 hr life between overhauls—exactly double the target overhaul life. Such a high initial overhaul life is unprecedented and we hope the right boys got a pat on the head.

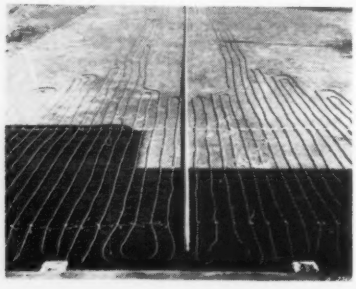
Bake my new radio speaker a crisp, golden brown please



Autos excepted, one of the strongest design groups today is much concerned with making things smaller and lighter. Already well established in radio, recent news that a ceramic wafer can now replace heavy magnets and coils, consolidates their position.

The ceramics are really sophisticated compounds of barium titanate and are baked in the form of thin discs, a few thousandths of an inch thick. In use, they respond to minute and rapid fluctuations in electrostatic fields—contracting radially with increases in the applied field. Bonded to a larger titanium disc, they produce a cupping action that (in turn) drives a speaker cone. The Mullenbach Division of Electric Machinery Manufacturing Co. worked on the project for six years.

Let's relax — and clear the snow off the driveway



Next time you buy a new house, don't forget to specify central heating for the driveway. It reduces snow-shovelling to a flick of a switch and heading for the most comfortable armchair.

A Connecticut firm of paving-contractors is now "packaging" electrically heated driveways and sidewalks for the folk who prefer to perform household chores in a prone position. The photograph shows how cable (in 100-ft. lengths) is laid on the garage apron and tracks, then covered with asphalt or concrete. Spacing wire 4 in. apart provides 30 watts per sq ft operating at 230 volts. Cost of clearing a 45-ft driveway all winter with this system is about $20.00. But won't the wife think up new tasks for her spouse to do with all the time he's saved?

All **Canada Iron** *Machinery is*

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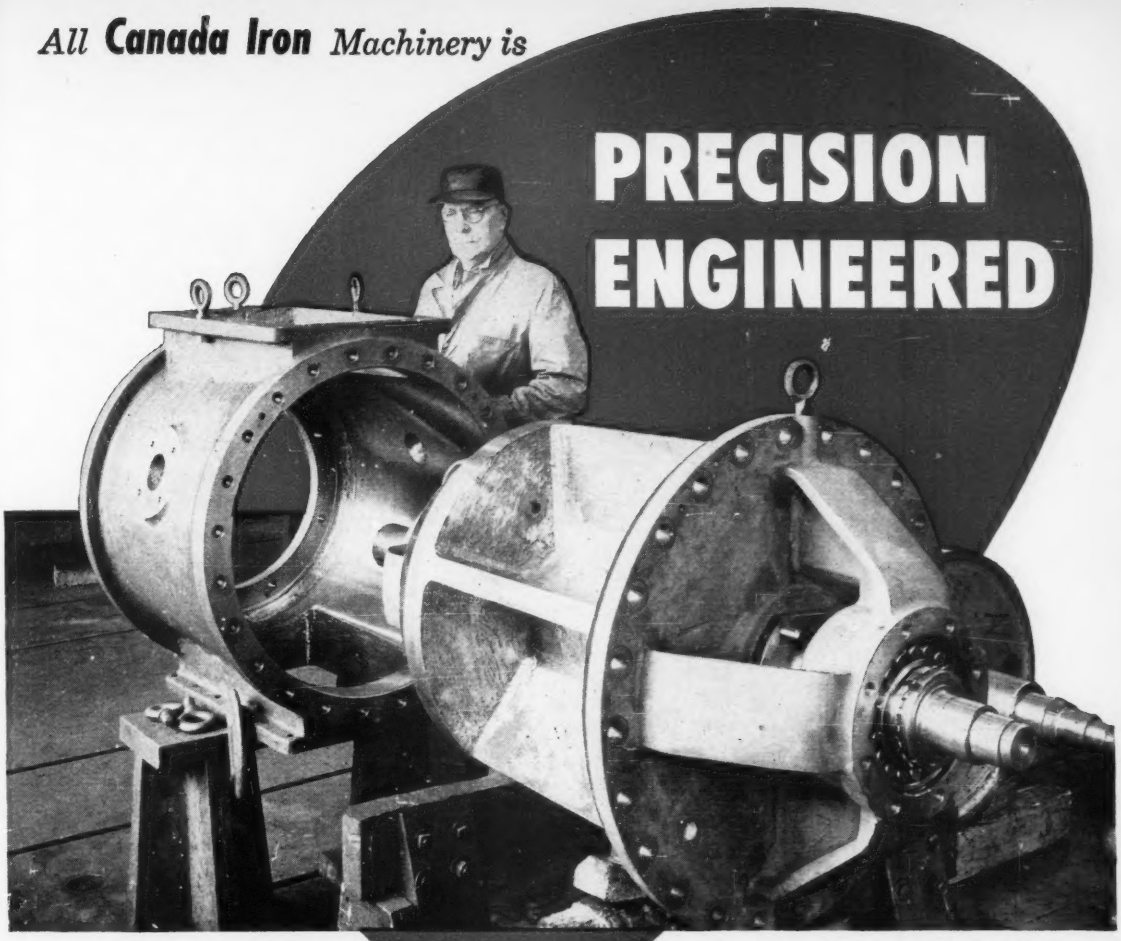

A Canada Iron craftsman checks the sub assembly of a housing and rotor, part of an air pressure feeder for the pulp and paper industry. Very close tolerances are essential before assembly. The unit's total weight is 7,400 lbs.

by MASTER CRAFTSMEN

Experienced in their craft,—conscientious in their work, the master craftsmen of Canada Iron take pride in the machinery they build. They have profited by years of practical knowledge, and you, too, will profit when you bring your problems, or your blueprints, to Canada Iron's engineering staff. For the machinery built by Canada Iron is precision engineered to function smoothly, giving you complete satisfaction. *Call Canada Iron.*

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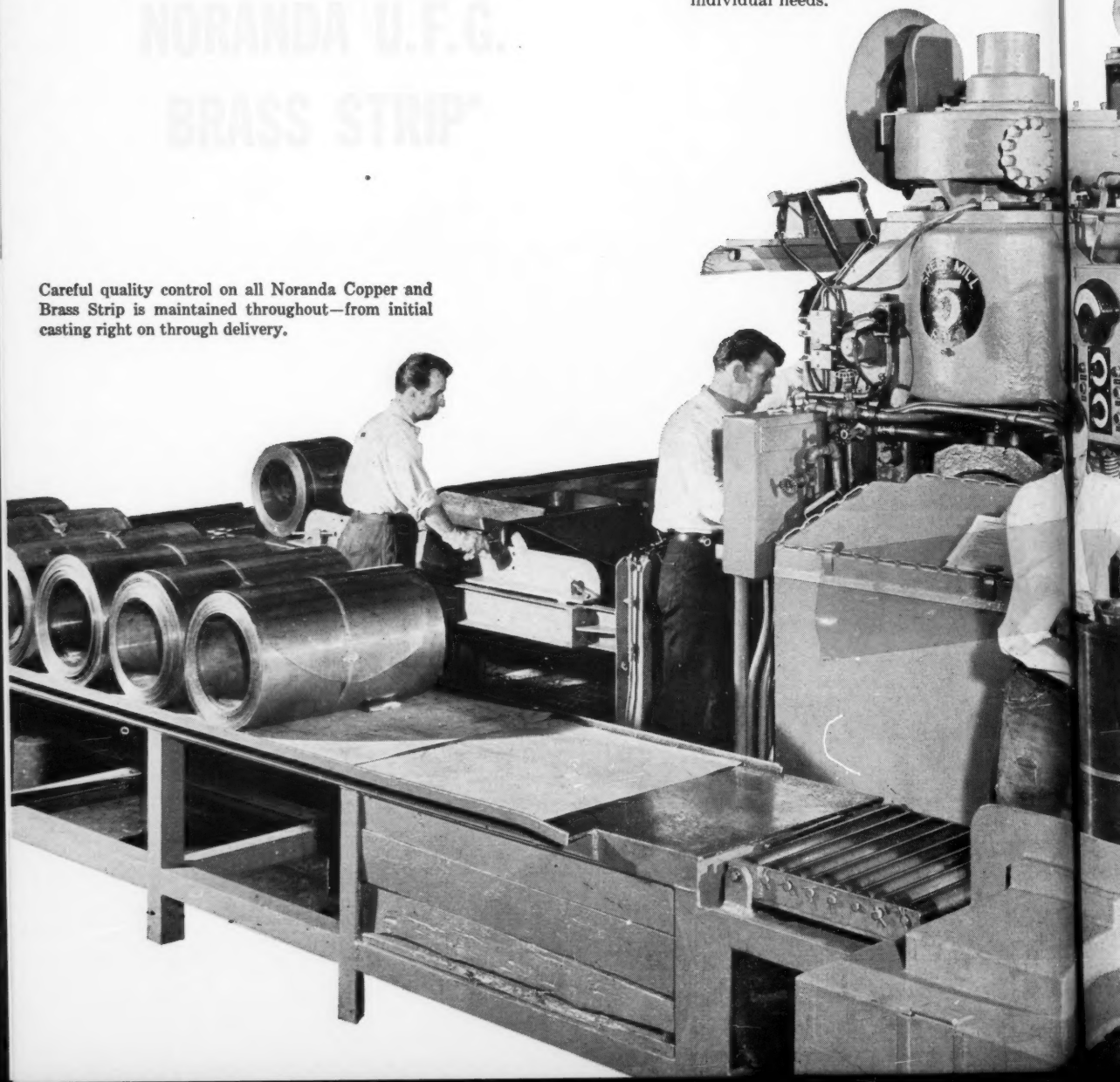
Circle number 108 on time saver card

FOR QUALITY PRODUCTS AT REDUCED COSTS USE POPULAR-PRICED NORANDA U.F.G. BRASS STRIP

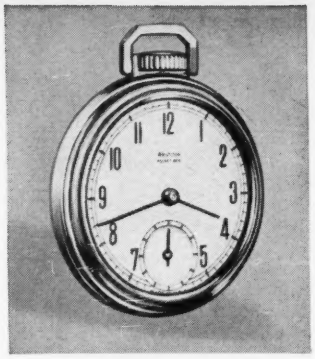
Noranda *Ultra-Fine-Grain Brass Strip offers these three features—an absolute minimum of polishing, ability to take a fine plated finish and most important, low price—a combination of advantages that adds up to better quality at lower cost.

Noranda Ultra-Fine-Grain Strip is fabricated to meet your forming needs *exactly*. It is readily formed, stamped and shallow-pressed; and its fine grain structure presents a surface so smooth and even that most finishes require only a color buff.

To get the complete story, SEE THE MAN FROM NORANDA. Our Technical Service Representatives will be pleased to assist you in the selection of correct grain size and temper to suit your individual needs.



Careful quality control on all Noranda Copper and Brass Strip is maintained throughout—from initial casting right on through delivery.



Plated U.F.G. beauty is apparent in these fine products. Case of the Westclox Pocket Ben by Western Clock Company, Ltd., and fishing lures by Lucky Strike Bait Works Ltd. are outstanding examples of low-cost fine finishes obtained with U.F.G. Brass Strip.

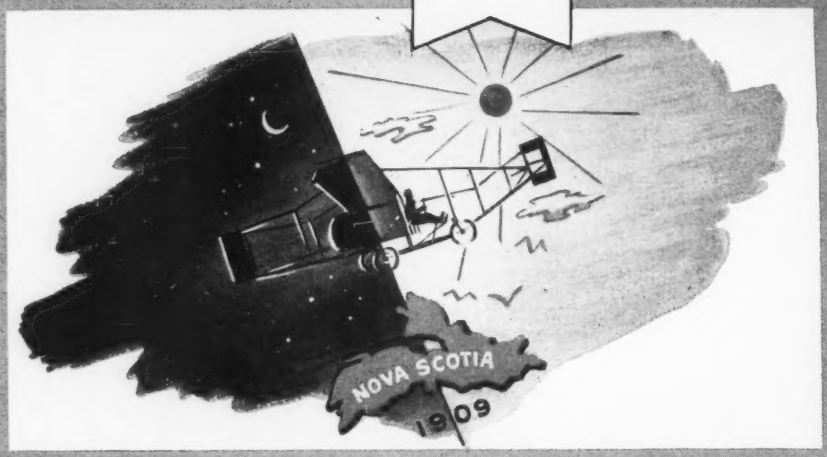
Noranda makes an extensive range of copper and brass strip and sheet to meet a wide variety of drawing, spinning, stamping and engineering applications. Because so many different characteristics can be "built into" copper alloys you can meet almost any product or production requirement with ease. Regardless of the material you are now using, it will pay you to discuss your strip and sheet needs with the Man From Noranda...chances are he can show you new ways to use copper alloys to better advantage.

Noranda Copper and Brass Limited

SALES OFFICES: MONTREAL • TORONTO • LONDON • EDMONTON • VANCOUVER

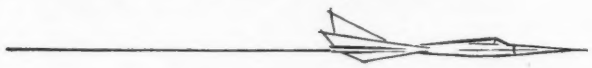
COPPER AND BRASS LTD. **Noranda** *The key to your best opportunities in metals*

A CANADIAN FIRST



THE FIRST AIRCRAFT FLIGHT IN THE BRITISH COMMONWEALTH

FIFTY YEARS AGO, *on February 23rd, 1909, at Baddeck, N.S., J. A. D. McCurdy piloted the first aircraft ever to fly in the British Commonwealth. The success of this epic event represented more than two years of intensive, scientific investigation and experiment by a group which included the distinguished Dr. Alexander Graham Bell. In addition to being pilot, McCurdy invented the tricycle landing gear and aileron, which were two important factors in the success of this first flight. The 50th anniversary of this occasion is being celebrated on February 23rd, 1959, and Hon. J. A. D. McCurdy, the oldest living pilot in the world, will be on hand.*



In the technological advancements in Canadian-built aircraft, now marked by fifty years of flying in Canada, Modern Metals have played a vital role in weight reduction and in combatting high temperature, corrosion and stress.

As specialists in the field of Modern Metals, and in cooperation with major sources of supply, we bring you first-hand knowledge, information and technical assistance—all these to help you improve your product or process. These Modern Metals, in all forms, are available from our warehouses located conveniently to serve you.

For Assistance . . . For Service — "CALL ALLOY"

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Announcing new . . .

DURACRON*

THERMO-SETTING ACRYLIC ENAMEL . . .

From Pittsburgh's Springdale Research Centre comes news of a distinctive new development in industrial enamels. Duracron Thermo-setting Acrylic Enamel is not merely another modification of an existing vehicle—it is a basically new chemical composition and a revolutionary departure from the baking enamels used today. Because of its unique properties Duracron is particularly suitable for the finishing of household appliances, air-conditioning units, metal furniture, partitioning, siding, tile and cabinets—in brief, any surface on which it is desirable to improve present baking enamels.

Only new Duracron offers you all these advantages over other baking enamels:

- Superior adhesion to bare metal or primer.
- Outstanding toughness, hardness, and impact resistance either as a one-coat enamel or over primer.
- Remarkable colour and gloss retention for prolonged periods.
- Greatly increased resistance to detergents.
- Will not show stains from grease, inks, fruits, mustard, ketchup, etc.
- Gives improved resistance to salt spray, humidity and other corrosive atmospheres.
- Provides a sanitary, taste-free, mar-proof liner for food cabinets.
- Retains film continuity under severe impact.
- Available in clear, white and a range of colours.

THE REVOLUTIONARY NEW ONE-COAT INDUSTRIAL ENAMEL

This Finish Started with Research

PITTSBURGH PAINTS

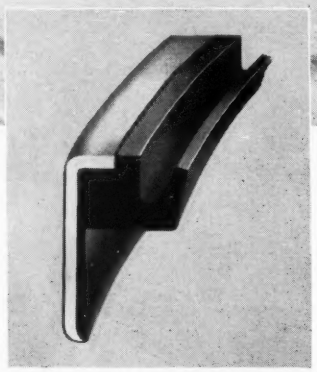
CANADIAN CPI PITTSBURGH INDUSTRIES LIMITED

*Registered

Circle number 111 on time saver card

MORE ABOUT THE GARLOCK **2,000**

(above) Fresh driver takes over underway during 50,000 mile test conducted by Kiekhaefer Corporation, makers of Mercury Outboard Motors. *(right)* KLOZURE Model 71A7 used on the Mercury has exclusive non-abrasive, free running sealing element resistant to oil, water, grease, heat and cold.



50,000 MILE OUTBOARD TEST

PROVES ENDURANCE OF GARLOCK KLOZURE* *OIL SEALS, TOO!*

In a fantastic non-stop endurance run equal to 20 years of average family outboarding, Garlock KLOZURE Oil Seals maintained positive sealing against grease and water without sign of physical wear or deterioration. Applied on the steering swivel shaft of two Mercury Mark 75E outboards, KLOZURES worked 'round the clock for 68 straight days keeping grease in the bearings. Hard knocks from rough water, floating obstacles, and foreign matter picked up at surface speeds averaging 30 miles per hour, could not injure the KLOZURES.

What better proof is there of long life and dependability! Garlock KLOZURE Oil Seals are compact, easy to install, and are available from one of the largest stocks of standard sizes for shafts from $\frac{1}{8}$" to 44". Whether it's in boating or industry, specify Garlock for the most effective seal on the market.

KLOZURES are another of the Garlock 2,000 . . . two thousand different types of packings, gaskets, and seals. The only complete line. It's one reason you get unbiased recommendations from your Garlock representative. Call him or write for KLOZURE Catalog 20.

*Registered Trade Mark

GARLOCK

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THE GARLOCK PACKING COMPANY OF CANADA LTD.

General Offices: Toronto, Ont • Branch Offices: Hamilton, Montreal, Winnipeg, Edmonton, Vancouver

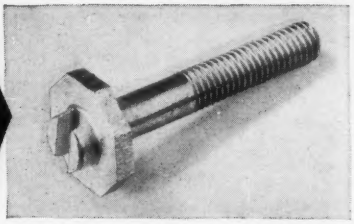
Circle number 117 on time saver card

Two (or more) for the price of one!

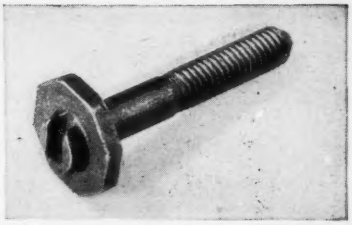
Here's PROOF of savings...

by STELCO COLD HEADING

Manufacturer 'A' saves 50% (approx.) on overall cost

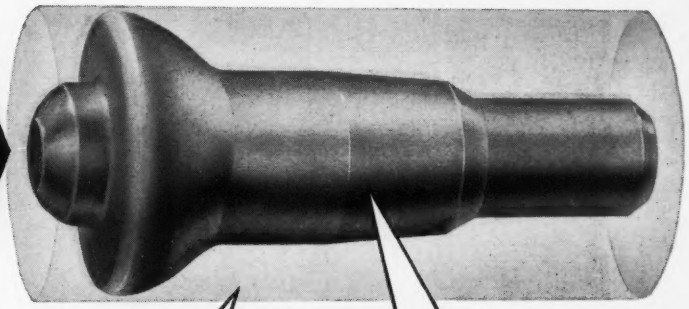


Enlarged view of part previously produced by machining.



Part as now produced by STELCO Cold Heading at half the cost.

Manufacturer 'B' uses 63.5% less material



Material blank previously used for machining (actual length 2¼") .550 lbs.

Finished part, cold headed by STELCO. Material used .200 lbs.

Any part that can be machined from rod stock is potentially suited to production by cold heading. This technique offers speed of production* without scrap loss — and therefore low unit costs. Costs remain attractively low even when one or more secondary operations is required. In addition, cold working increases the tensile strength of the metal, and produces an excellent surface finish.

Quality of cold headed products is high, because metals must be resistant to cracking and free from defects to be satisfactorily upset or extruded cold.

Stelco's Engineers can tell you quickly whether *your* fasteners or contoured parts can be made by cold heading. If so, the savings are likely to be considerable. Send in your specifications with a drawing and an idea of the application, and you will receive prompt attention.

Any Stelco Sales Office is at your service.

THE STEEL COMPANY OF CANADA, LIMITED

Executive Offices: Hamilton and Montreal

Sales Offices: Halifax, Saint John, Montreal, Ottawa, Toronto, Hamilton, London, Windsor, Winnipeg, Edmonton, Vancouver
J. C. Pratt & Co. Limited, St. John's, Newfoundland

57122.8

**In one recent instance speed of production was increased from 30 per hour to 6000 per hour by converting from automatic screw machine production to cold heading.*

Circle number 134 on time saver card

ASK ANACONDA

for the answer to your metal problems

VAPOR HEATING LTD. did . . .

When Vapor Heating (Canada) Limited, Montreal, encountered a fabricating problem with the copper tubes and strips used in the manufacture of finned tube heating and cooling units, Anaconda solved it by developing 'Special Temper' copper tubes and strip now standard in 'Vapor Fin' heat exchangers. Mr. Norman English, Executive Vice-President, centre and Mr. G. H. Coull, Vice-President, Vapor Heating (Canada) Limited, right, discuss the use of 'Special Temper' tubes in a direct expansion cooling coil with Mr. C. T. Meredith, Anaconda Sales Representative.

"We always turn to Anaconda for technical assistance on problems involving the use of copper", said Mr. Coull.

C-5907

BUY CANADIAN

Don't say Copper...SAY

ANACONDA*

ANACONDA AMERICAN BRASS LIMITED
New Toronto, Ontario
Sales Offices: Montreal and Vancouver

**Trade Mark Reg'd*

For general information on Anaconda Copper and Copper Alloys, write for Publication B-32.

Anaconda American Brass Limited,
New Toronto (Toronto 14), Ontario. Dept. DE-1.

Name.....

Address.....

Place..... Prov.....

Circle number 103 on time saver card

The Human Eye, Nature's inspiration for the camera, can convert wavelengths of blue-green light measuring as little as 400 microns into visual perceptions that are truly life-size. Yet this entire human mechanism occupies space less than 1″ in diameter.

Tiny New Potentiometer, shown actual size, is designed to add space-saving precision to missile and aircraft servo mechanisms. Two MPB bearings in it assure accurate, low-torque shaft rotation — a vitally important benefit in sub-miniature components.

Man With Miracles. This is Maurice Hebert, one of MPB's Sales Engineers. He'll personally help you choose the correct MPB bearing to reduce friction and increase the precision of your instruments — while keeping your operating costs low with trouble-free service.

Miracles in Miniaturization

ACTUAL SIZE OF THE MPB BEARINGS IN POTENTIOMETER SHOWN ABOVE

The Smaller The Better is often completely true. Engineers now know that miniaturization is the surest method of developing new or improved components for many of the latest developments in modern industry. But, as components become smaller, the problems of maintaining high precision and long service life become larger — and the call for MPB bearings constantly increases. MPB answers with the most experienced engineers in the miniature bearing industry, and advanced research facilities . . . producing over 500 types and sizes of bearings from ⅜″ O.D. down, with specials as required. We welcome your request for engineering advice, our catalog, or both.

Write MPB, Inc., 702 Precision Park, Keene, N.H. In Canada: Lyman Tube & Bearings, Ltd., Montreal, Toronto, Hamilton, London and Winnipeg.

MINIATURE PRECISION

MPB

BEARINGS, INC.

Helps you perform miracles in miniaturization

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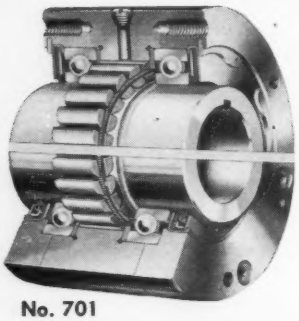
product from news — United Steel CORPORATION LIMITED



No. 701

Morse Cam Clutch

The action of the Morse Cam Clutch can be compared to a self-contained rachet with an infinite number of teeth. They are available in five series:

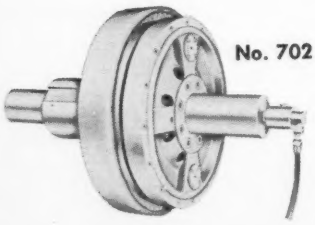
(1) **P.B. series**—medium or slow speed indexing and backstop applications.

(2) **H.T. series**—especially designed for indexing, it can also be used for general duty or backstop.

(3) **M.C. series**—for high speed overrunning and backstop applications as well as for heavy duty indexing.

(4) **K. series**—for heavy duty overrunning, backstop, and indexing applications.

(5) **200 series**—a low cost unit for backstop and indexing.



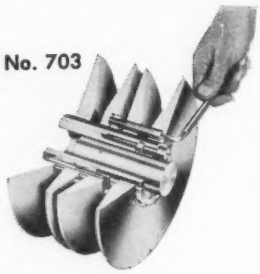
No. 702

Dodge Air Grip Clutch is most sensitive, responsive air clutch available.

The compact new Dodge Air Grip Clutch is the most sensitive, responsive air clutch available. The clutch may be "inched" or thrown into full engagement, as required. The air seal disc is so located that it does not contact the heat generating plates. This, together with internal ventilation makes for cooler operation and longer life. Quick release valves can be supplied where instant disengagement is desired.

Variable sheave provides quick, easy one-point adjustment

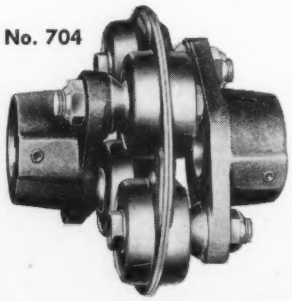
The Dodge Variable Speed Drive uses this compact variable sheave for quick, easy, one-point adjustment. All parts lock or unlock as a unit—positively, easily. Pitch diameter setting can be read directly on dial. Units are dynamically balanced for true running-operation.



No. 703

Coupling protects against shock, vibration, uneven torque impulses.

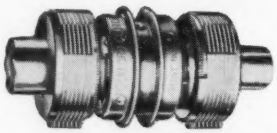
The Morse Morflex Coupling provides protection from shock, vibration and uneven torque impulses. The neoprene preloaded biscuit assembly is designed for uniform stresses and linear deflection. It eliminates metal to metal contact between driver and driven members, requires no lubrication, is unaffected by dust, dirt and weather. Available in stock bores from ¼" to 2⅞" plain, keyway and setscrew.



No. 704

Disc clutch is ideal where there are space limitations.

The Morse Pullmore Multiple Disc Clutch is ideal where design space limitations are important, because it transmits heavy loads in comparison to the clutch diameter. Double units may be applied to obtain forward and reverse movement, high and low speeds or for use as a clutch and brake. Capacities range from 1 to 90 H.P. at 500 R.P.M.

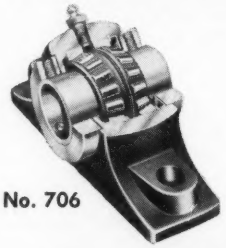


No. 705

The Dodge-Timken Type Pillow Block

Offers many advantages including ruggedness, high speed capacity, positive locking to the shaft and low price.

The housings are as compact as they can be made without sacrificing the ruggedness which is characteristic of all Dodge Roller Bearings. These bearings have high radial and thrust load carrying capacities and are capable of handling most combinations of loads found in normal applications.



No. 706

All of these items illustrated here are available for immediate delivery from stock at United Steel Corporation. These are just a few items from our tremendous range of mechanical power transmission equipment. Our warehouses are located at strategic points across Canada. Our staff of transmission experts is ready and waiting. Drop us a line or fill in the coupon below for an answer to your transmission problems.

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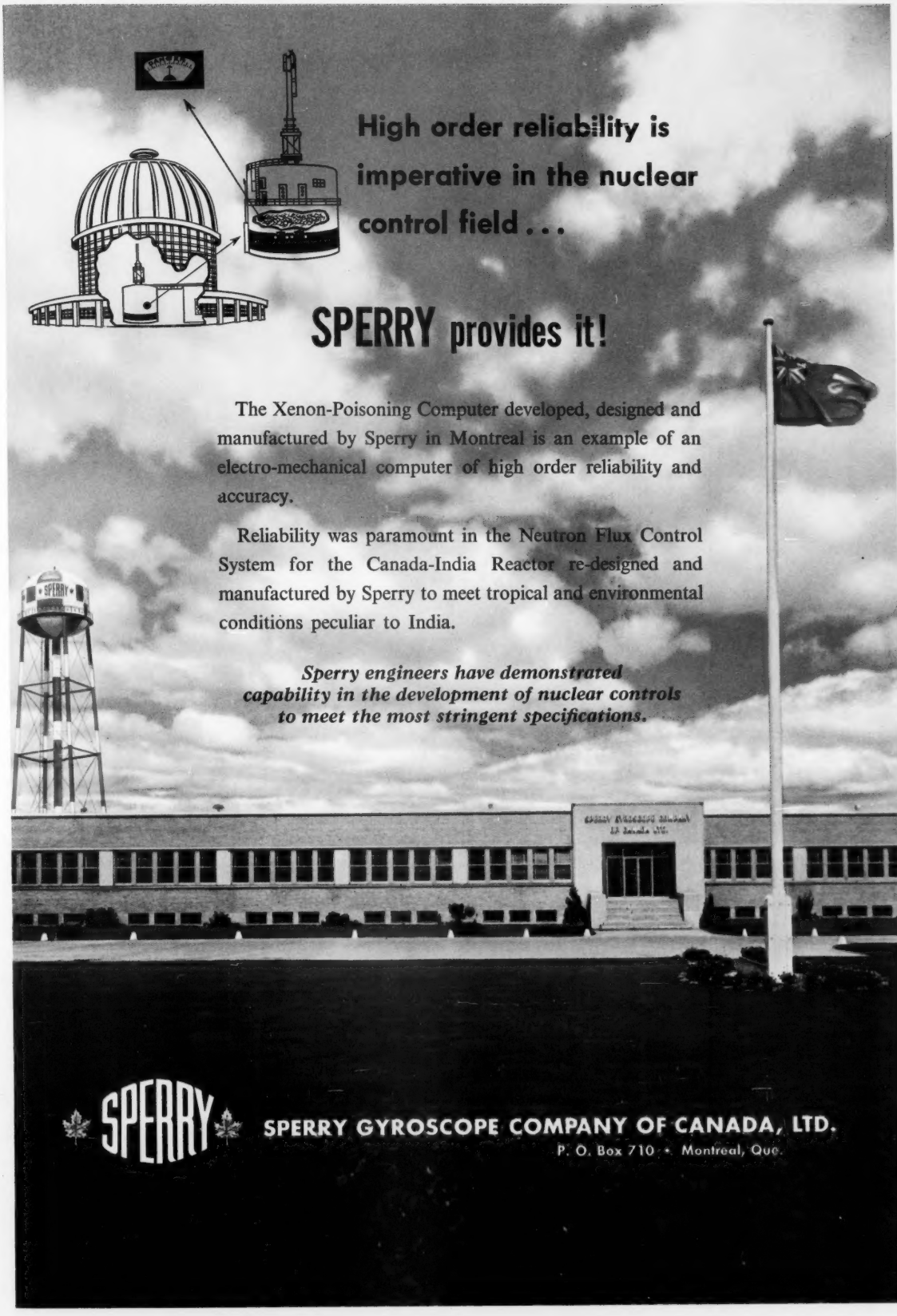
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The Xenon-Poisoning Computer developed, designed and manufactured by Sperry in Montreal is an example of an electro-mechanical computer of high order reliability and accuracy.
Reliability was paramount in the Neutron Flux Control System for the Canada-India Reactor re-designed and manufactured by Sperry to meet tropical and environmental conditions peculiar to India.
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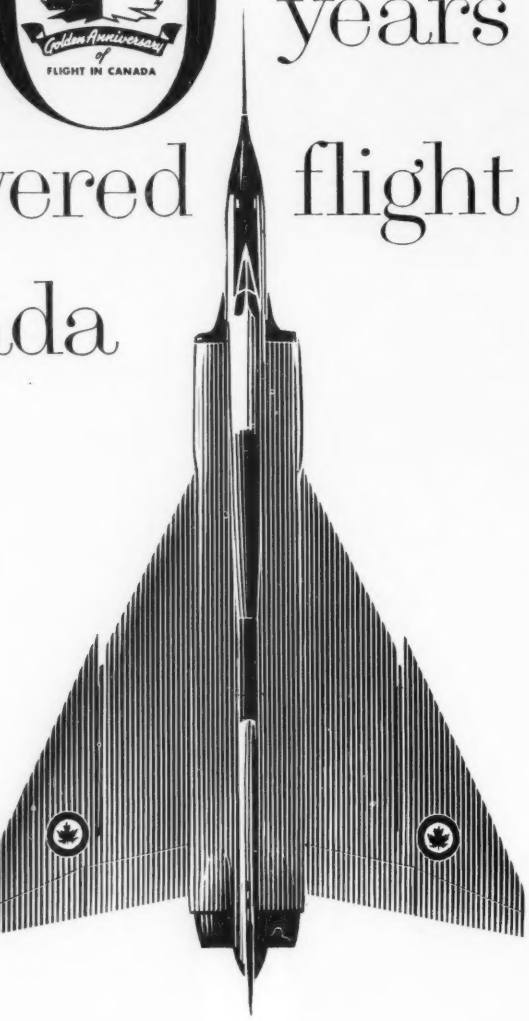
1909 1959 Golden Anniversary of FLIGHT IN CANADA

1909–1959

From the DART in 1909 to the Arrow in 1959 a pattern of aeronautical accomplishment has been dramatically recorded in Canada. The past half century of Canada's growth and increasing stature has been greatly accelerated by the swift and vigorous momentum of the men and machines of the Air Age.

Well established in the Jet Age, Canada's aeronautical resources will continue to meet the urgent requirements of a nation on wings.



AVRO AIRCRAFT LIMITED AVRO AIRCRAFT

MEMBER: A.V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

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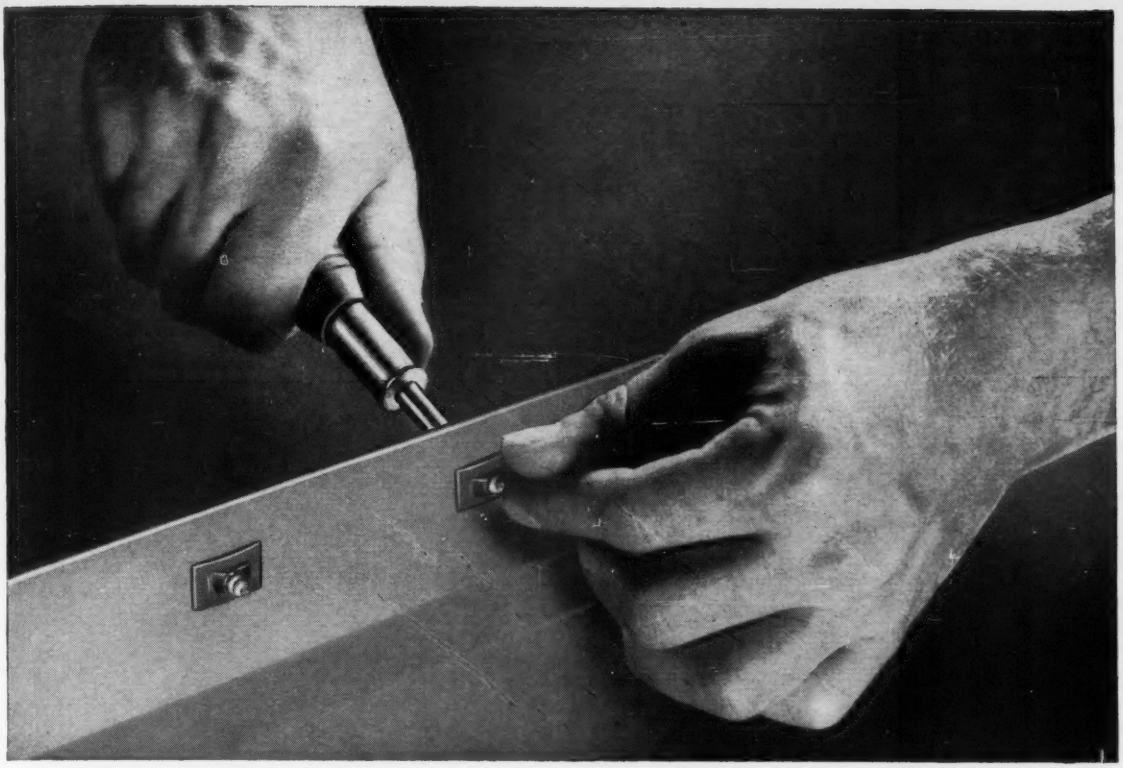

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FASTENERS

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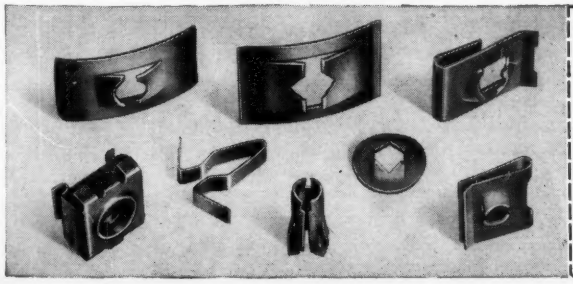
In even the most mechanized plant, there is still a good deal of hand assembly to be done. It's vital to your profits that these hand operations be done quickly and expertly with no waste motions. To be sure that your big investment in these hands is paying a good return, look into Speed Nut Fasteners. These modern efficient fastening devices are cutting costs for thousands of leading manufacturers throughout the world. Mail this coupon today for complete information.



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Please send me complete information on how Speed Nut Fasteners can reduce my costs and improve my product.

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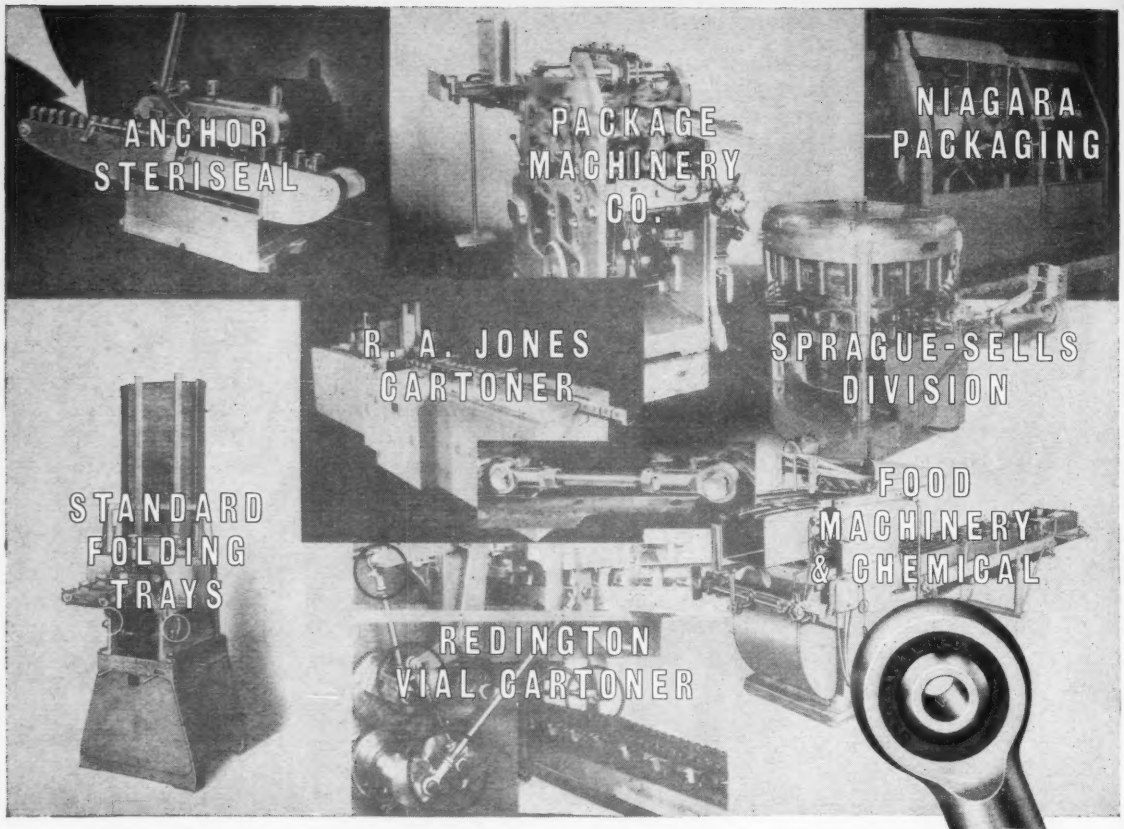

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HEIM *Unibal* SPHERICAL BEARINGS AND ROD ENDS

Cartoning machines fold package inserts and assemble them with the bottle or vial, insert them in a carton and deliver the finished package ready for shipment.

Rotary Fillers draw liquid or semi-liquid materials into a cylinder and discharge them, in accurately measured amounts, into containers.

Casers assemble a load of cans, and insert the load into a case — at unusually high speeds.

The Steriseal machine is used for high production steam vacuum sealing of glass containers.

Bottles, jars, tubes, and a variety of articles are fed from the labeling machine to the cartoner which opens the folding box, inserts the contents, then tucks and delivers the complete package.

The Cigar Wrapper-Bander cellophane wraps and bands cigars faster than two a second.

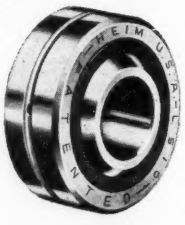
Folding trays, for tomato packaging and other types of fruits and vegetables, are formed from flat stock.

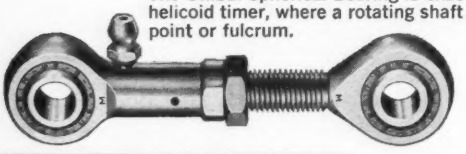
Imprinting of the package is done in one pass through some machines.

The motions involved in the push-pull linkages of this automated machinery are intricate and ingenious. Heim Unibal Spherical Bearing Rod Ends are used where it is necessary to correct inherent misalignments, and where close accuracy of fill and smooth operation at each station are mandatory.

They are used as suspended bearing supports for belt rollers. They change motion from vertical to horizontal plane, and vice versa.

The Unibal Spherical Bearing is exactly right as the support on one end of a helicoid timer, where a rotating shaft moving in all directions requires a focal point or fulcrum.





Quick and simple push-pull linkage assemblies are possible with one female threaded and one male threaded Unibal rod end. There is practically no limit to the length of linkages possible.

WRITE FOR CATALOG WHICH GIVES COMPLETE DATA, OR LET OUR ENGINEERING DEPARTMENT HELP WORK OUT DETAILS OF YOUR APPLICATIONS.

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FACTORY REPRESENTATIVES AND DISTRIBUTORS FOR CANADA

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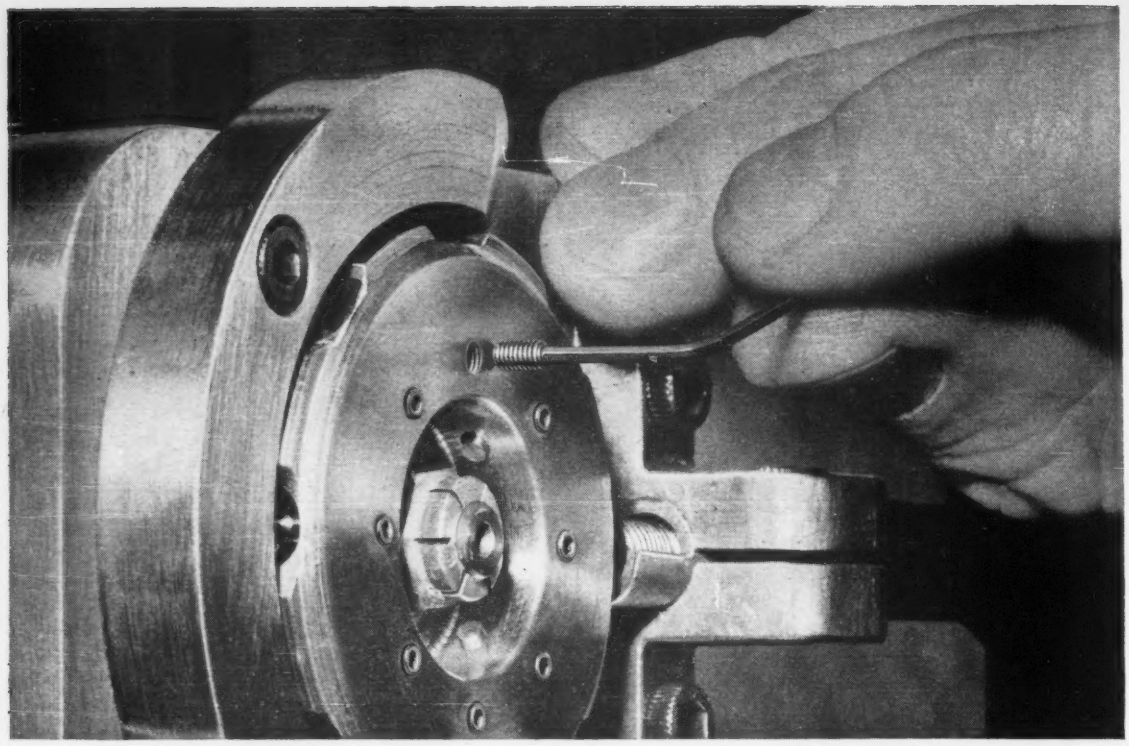

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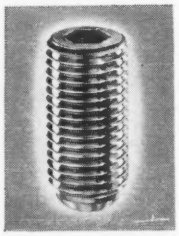
#0	D .060 F .028	..	80	1/16	..	.5	.01
		..	80	3/32	..	.5	.01
		..	80	1/8	..	.5	.01
		..	80	5/32	..	.5	.01
		..	80	3/16	..	.5	.01
		..	80	1/4	..	.5	.01
#1	D .073 F .035	..	72	1/16	..	1.5	.02
		..	72	3/32	..	1.5	.02
		..	72	1/8	..	1.5	.02
		..	72	5/32	..	1.5	.02
		..	72	3/16	..	1.5	.02
		..	72	1/4	..	1.5	.02
#2	D .086 F .035	56	..	1/16	1.5	..	.03
		56	..	3/32	1.5	..	.03
		56	..	1/8	1.5	..	.03
		56	..	5/32	1.5	..	.03
		56	..	3/16	1.5	..	.03
		56	..	1/4	1.5	..	.03
#3	D .099 F .050	48	..	3/32	5.0	..	.04
		48	..	1/8	5.0	..	.04
		48	..	5/32	5.0	..	.04
		48	..	3/16	5.0	..	.04
		48	..	1/4	5.0	..	.04

*Also available in stainless steel



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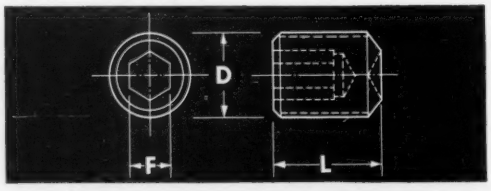

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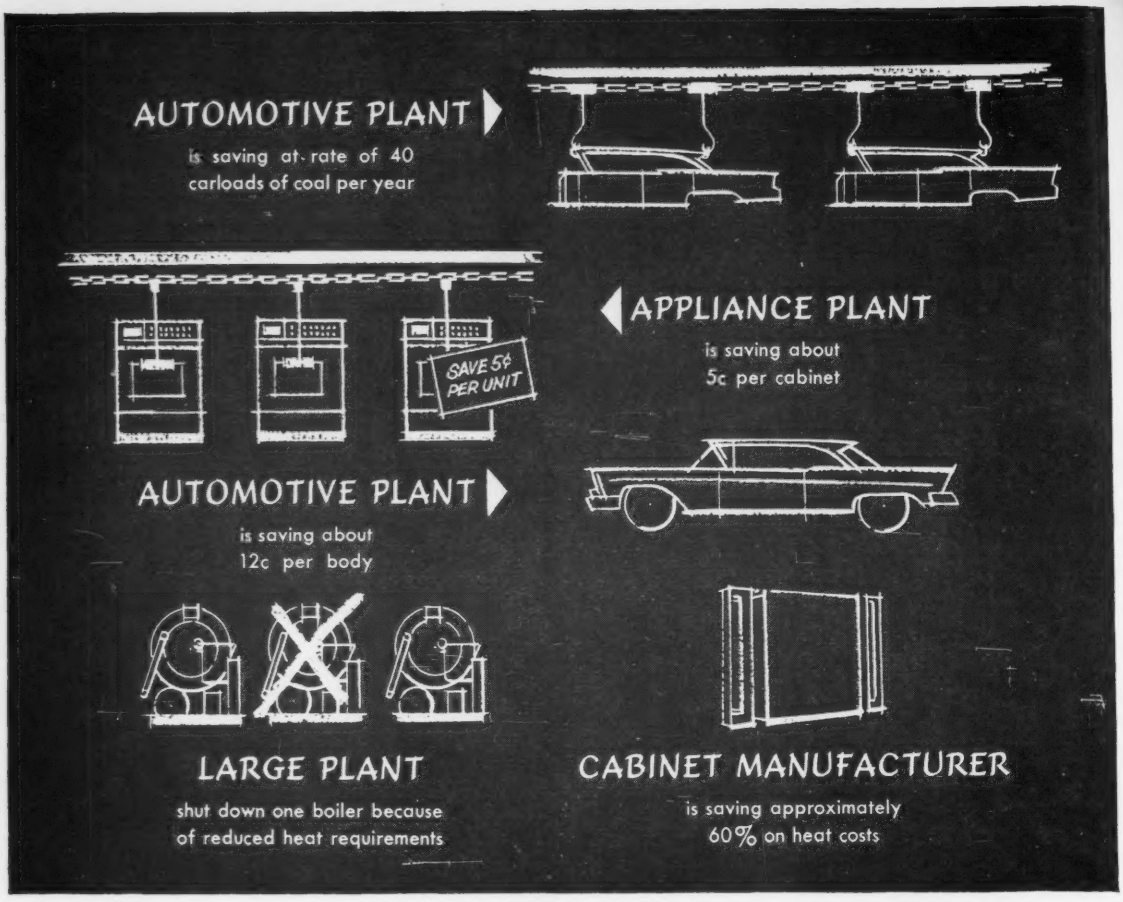

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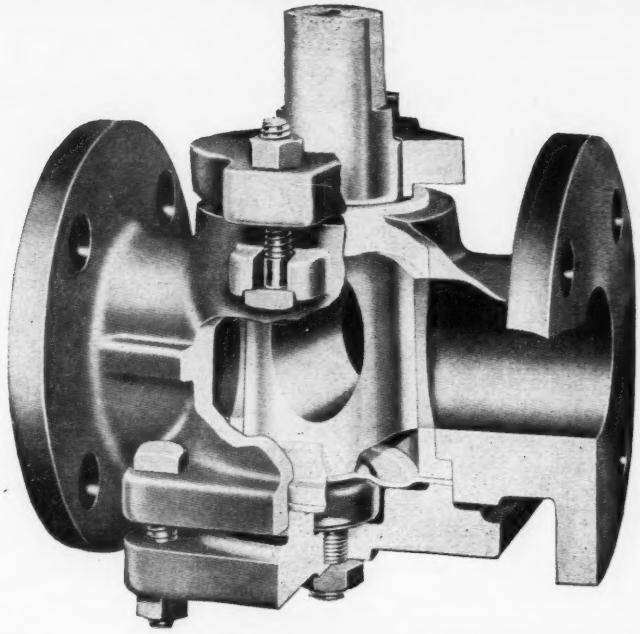

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DU PONT CANADA

PRODUCT ENGINEERING NEWS

TYPICAL APPLICATIONS OF MOULDED NYLON

Moulded Nylon Now Used by Leading Water Pump Manufacturers in Nozzles, Impellers, Valve Plates and other Components

Pump Producers Find Moulded Nylon Outlasts Metal — Increases Efficiency and Reduces Costs

A current manufacturing trend indicates that nylon may soon be found as frequently in pumps as it is now in countless products, ranging from textiles to tires.

Some of Canada's leading pump manufacturers are switching from metal to moulded nylon in a variety of pump parts, and discovering that, in making the switch, they get substantial cost reductions and higher efficiency.

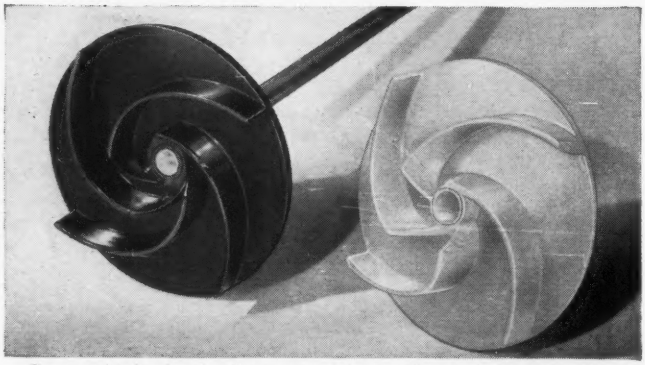
Parts in which nylon has been replacing metal are venturi tubes, nozzles and impellers in jet pumps; impellers in sump pumps; valve plates in piston pumps; and nylon linkage-tubing in various types of water pumps. Success so far has stimulated manufacturers to experiment with other components moulded of nylon.

Such firms as S. A. Armstrong Limited, Toronto; Canadian Fairbanks-Morse Company Limited, Montreal; Otaco Limited, Orillia, Ont.; Pumps and Softeners Limited, London, Ont., are now using the moulded parts.

Since water pumps are essential in country homes, motels, summer cottages, farms and other buildings in areas not serviced by city water mains, the cost-efficiency factor here is of direct benefit to thousands of Canadians.

Pumps producers report that among the advantages of the moulded nylon are rust-proofness, light weight and the smoothness of its surface which reduces abrasion and friction, permitting greater output by the pump. This is particularly significant, for instance, in farms where silt-bearing water erodes metal surfaces, and metallic water content in wells tends to corrode or scale the metal. These conditions leave the nylon practically unaffected.

One measure of this effectiveness was found in a nylon impeller introduced into a sump pump by *Fairbanks-Morse*. The one-third horsepower motor, when equipped with a brass impeller, could evacuate water at a rate of 3,800 gallons an hour. Substitution of a nylon impeller in this sump pump increased the output to 4,200 gallons an hour. The nylon impeller now is found in deep and shallow well pumps and in both submersible and above-ground sump pumps produced by this company. Nylon tubing is also being used with increasing frequency.



These moulded nylon impellers are used in Canadian Fairbanks-Morse sump pumps. This type of nylon impeller increased pump evacuation capacity from 3,800 to 4,200 gallons an hour.

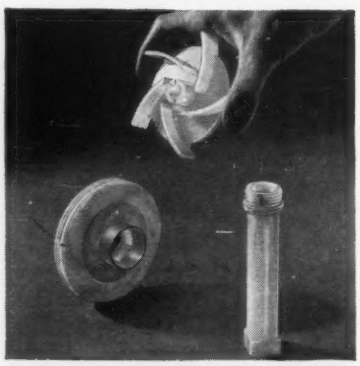
For its piston-type pump, Canadian Fairbanks-Morse uses a valve plate moulded for it by CANADIAN GENERAL ELECTRIC COMPANY, Cobourg, Ont.

Otaco Limited is another Canadian pump manufacturer using "Zytel" for impellers and venturi tubes, jet nozzles and nylon tubing. It has reported as much as 17 per cent increase in efficiency as a result. These parts are moulded by TORONTO PLASTICS LIMITED.

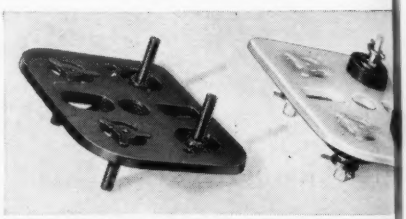
S. A. Armstrong Limited has replaced metal venturi tubes and nozzles in its shallow well pumps with nylon units, also moulded by Toronto Plastics. Spokesmen for the company report that the anti-abrasion effect of the "Zytel" provides longer life than machined castings. The unit cost was also reduced even in the early stages of production when the cost of the mould had to be included.

Pumps and Softeners Limited also uses moulded venturi tubes in its water pumps.

All of these parts are moulded in Canada from "Zytel" nylon resin, manufactured in Canada by Du Pont of Canada. The trend toward nylon components in pumps likely will continue. In addition to experiments testing its use in other parts of water pumps, investigations are going on to determine how it may be incorporated into pumps for such equipment as washing machines.



These two impellers and venturi tube, moulded of "Zytel" nylon resin by Toronto Plastics Limited, are rust-proof and light weight, with lower friction and abrasion characteristics than similar metal parts.



Nylon valve plates have been replacing metal units in piston pumps.

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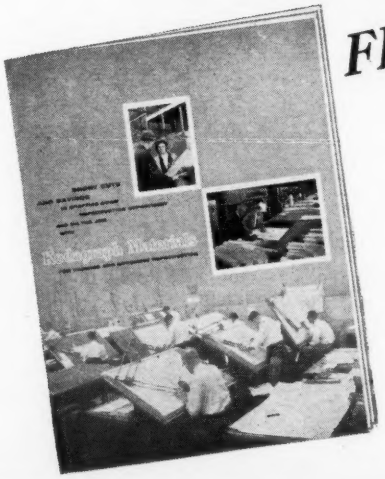

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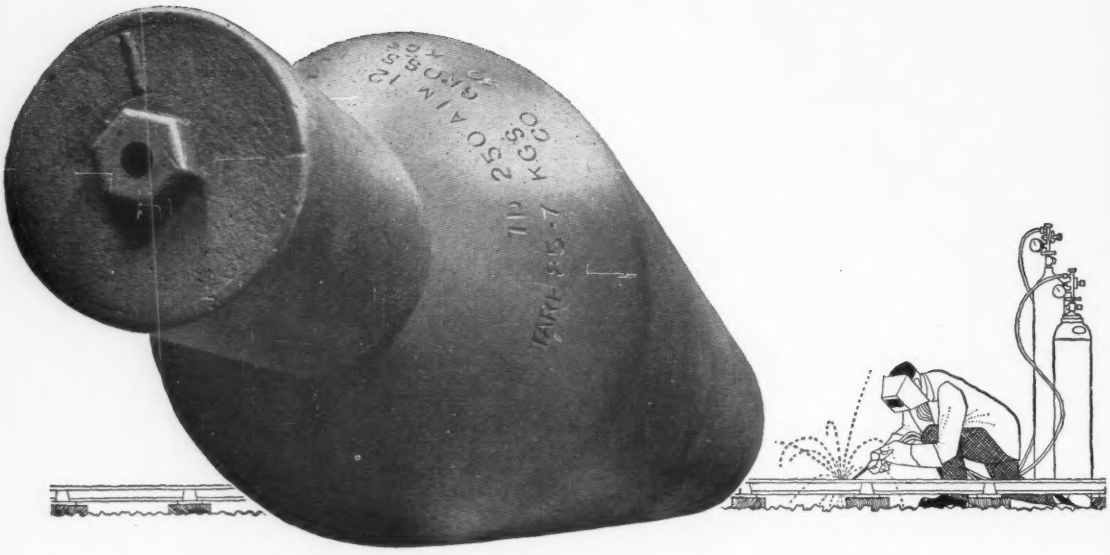

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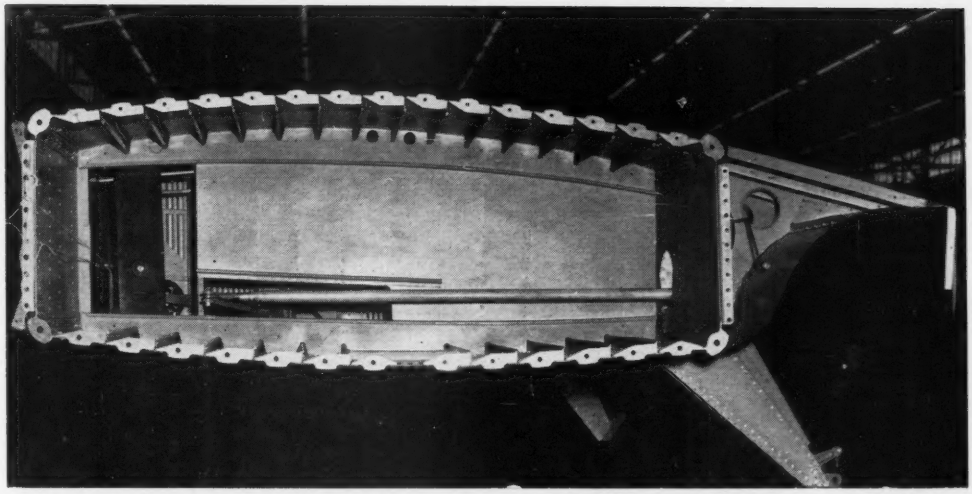


Fig. 1. Photograph shows inboard end of outer wing panel with all attachment fittings drilled and faced up.

Caribou wing is rugged yet refined

There's nothing new about wing joints made by bolts in tension. This story tells you what makes them different on the Caribou

Michael Davy *De Havilland Aircraft of Canada Ltd.*

Each outer wing of the de Havilland (Canada) "Caribou" can be disconnected from the centre-section at a point just outboard of the engine nacelles; full interchangeability (aircraft for aircraft) exists at these joints.

Since the bending strength of the wing is distributed uniformly over the cross section (rather than being confined to one or two spanwise spars only) the joint also has to be continuous across the chord. Such a joint could have been designed with a line of bolts in shear, but the large number needed would have presented a formidable jigging problem, if full interchangeability were to be maintained. It was therefore decided to use tension bolts with relatively sloppy holes in the matching components. At first this choice may seem surprising, since tensile stress is known to be linked irrevocably with fatigue failure, but there are four powerful arguments to justify such a course. These are:—

(1) Bolt diameters can be chosen somewhat larger than the minimum necessary, without a significant penalty in weight. This results in relatively low working stresses in the bolts.
(2) The bolts can be torqued to a pre-tension. Subsequent fluctuations in bolt load (the usual cause of fatigue failure) thus become greater (or lesser) amounts of tension only, instead of complete reversals into compression. This greatly reduces the danger of fatigue failure.
(3) A tremendous statistical background exists on the fatigue behavior of bolts, far greater than could ever exist for components, unless manufactured by the thousand or more.
(4) If (in spite of the above arguments) the fatigue performance of the bolts were to become suspect, the bolts could be renewed at definite intervals, as a precaution.

It is timely to add here that wing joints made by bolts in tension are not uncommon; they have been used in one form or another on such successful aircraft as the DC3, DC4, Harvard, Mentor and Packet. The Caribou wing joint was developed from the same logical beginning as any of the above examples: it is notable not because it is novel, but because of the degree to which it has been refined.

The bolts used are the NAS 624 series, nickel steel, heat-treated to 180,000 psi. They have a thread form which resembles the British Whitworth (rather than the American standard sharp-cornered Vee), the threads being roll-formed, not machined.

continued

The bolt-head (which has a generous fillet where it meets the shank) is forged into a twelve-point wrenching form, permitting a smaller head than the conventional hexagon type, and a corresponding reduction in wrenching clearance. The bolts are arranged to lie with their axes on the centroids of the skin-stringer combinations they connect, to eliminate any eccentric bending that could otherwise be induced. Each bolt clamps together a pair of forged fittings connected to the structure on each side of the joint. The arrangement is shown diagrammatically in Fig. 1.

The design of these fittings involved a considerable amount of careful geometry, for their positions and proportions had to be reconciled with a suitable stringer layout. Moreover (for reasons of economy) it was desirable to have all the fittings identical when forged. Finally, the fatigue strength of the fittings had to be beyond question.

Stages in the design. After the preliminary work had been completed, a tentative drawing was prepared, from which a wooden model was made. In this three-dimensional form it was easier to appreciate the detail, and any changes that were considered worthwhile at this point were added to the model, which was then used to produce a batch of castings in tool plastic. The tool plastic had a quantity of aluminum chippings added to it before casting, a feature which improved its machinability after setting-up. A pair of castings was then machined to the finished shape and lightly bolted together as a matched set. At this stage, the detail geometry was again examined and it was established beyond doubt that the bowls of the fittings were large enough for the bolts to be installed and withdrawn, and wrenched without difficulty. Also, there had to be sufficient room in the bowls to permit the back-spotfacing operation required for the bolt seating. When all possible data had been gleaned from the plastic models, the original drawings were again revised as necessary, and used to manufacture castings, this time in aluminum alloy. Alcan 125 was used, primarily because of its good casting qualities. There now existed a set of fittings known to be geometrically suitable, and the second phase of development (concerned with the strength of the fittings) was started.

One of the fittings was machined to the correct shape and connected to a pair of stringers, in exactly the same way as that intended in the final arrangement. The area around the fitting was coated with Stresscoat (the brittle lacquer discussed in DE, November, 1958). This has the characteristic of cracking when the surface it is applied to carries a tension strain above a known amount, the crack lines running at right-angles to the direction of strain. The assembly was then subjected to a progressively increasing tension (typical of its forthcoming function in service) and a close watch kept for the first appearance or cracking in the lacquer, at the first sign of which the load was released (see Fig. 2). The point at which cracks first appeared was assumed to be "weak link" or point at which the stress concentration (and therefore fatigue damage) would be greatest. An electric-resistance strain gauge was then applied to this critical point and the test resumed.

As the load was increased, the gauge provided the load-stress relationship at the critical point. At the same time, the growth of the crack pattern was noted and analyzed. An ideal design would in theory have no critical point and all cracking would appear simultaneously: the manner in which the actual cracking appeared helped to establish the improvements that could be made in this regard. A fully developed crack

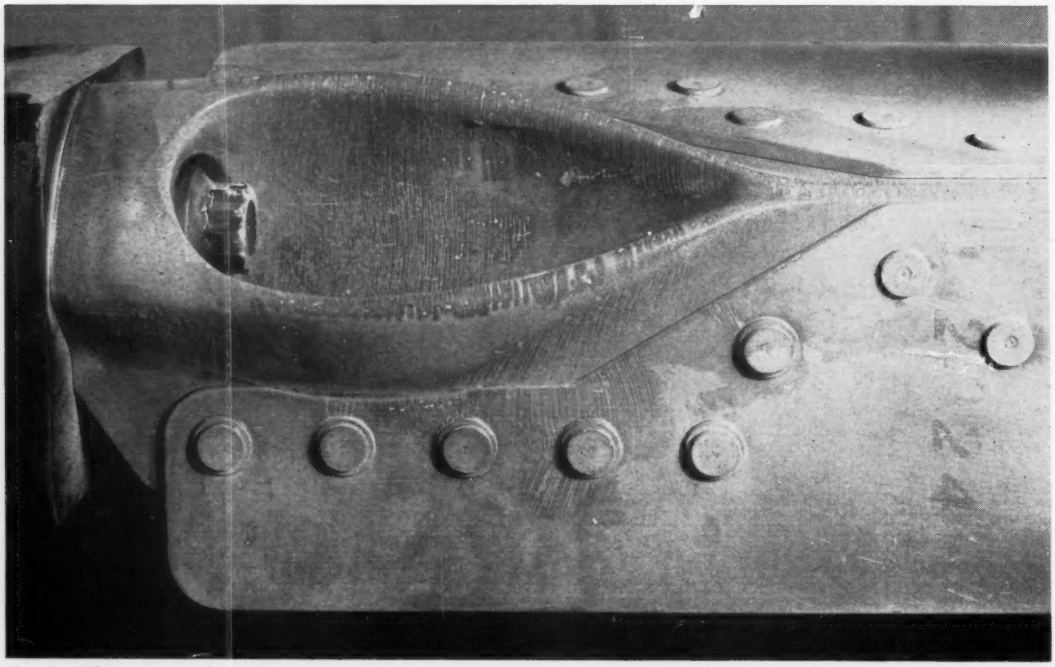


Fig 2. This unretouched photograph illustrates the partially developed crack pattern in one of wing corner fittings.

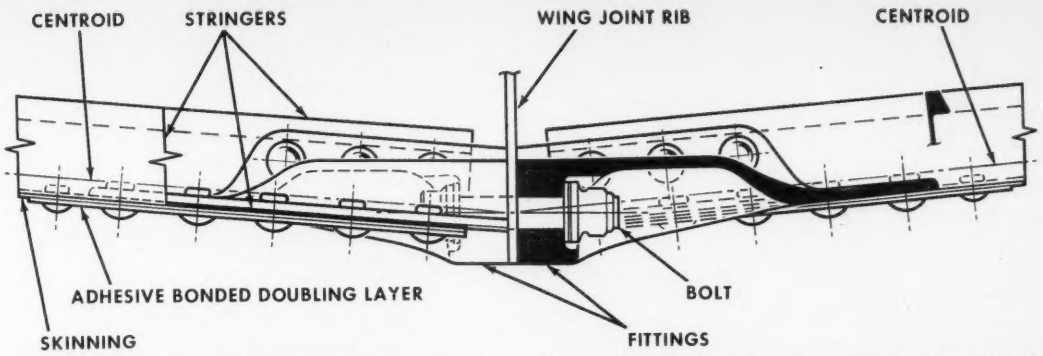


Fig 3. In this cutaway drawing it is easy to see relationship of lacquered parts with important wing joint rib.

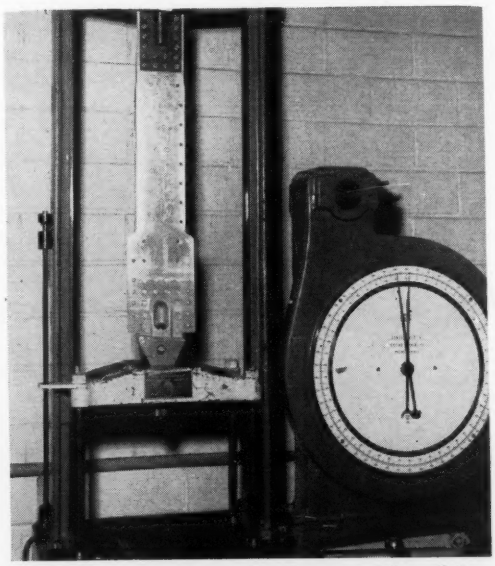


Fig 4 Test arrangement for bottom surface fitting.

Fig 5 Crack pattern-bottom surface fitting.

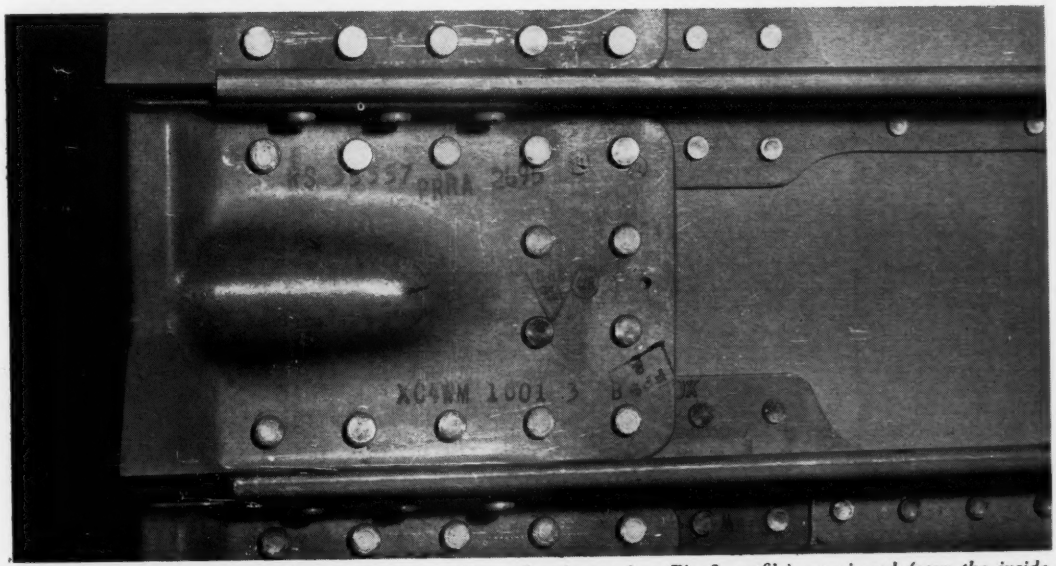


Fig 6. Showing fittings attached by rivets to skin and stringers (see Fig 3 profile), as viewed from the inside.

continued ▶

pattern for a bottom-surface fitting (with sequence marking) is shown in Fig. 5.

Finally, the load was increased until total failure occurred, whereupon the following points were considered:—

(a) What concentration of stress was demonstrated? The gauge values for the critical point could be compared with the calculated nominal value and an approximate ratio established.

(b) What could be done to reduce this concentration? A sensible rearrangement of the fitting proportions could be agreed upon in the light of the crack-pattern development.

(c) What was the manner in which final failure occurred? This had little relationship to the crack pattern, not necessarily being a tension failure.

Usually, quite minor modifications seemed enough to improve the performance of the fitting by a considerable amount. Drawings were then prepared for the expensive dies required to forge the actual flying sets of fittings, in high-strength 2014 aluminum alloy.

Upon delivery of these forgings, a pair of each kind was machined to finished shape. One of each pair was then subjected to an ultimate strength test, which in each case proved completely satisfactory. The other was prepared for a fatigue test, the results of which are at present being investigated.

Fig. 7 shows a corner fitting and the adjacent bottom-skin fittings, the arrangement on the top surface being similar. All fittings are assembled to the wing structure before being drilled and faced up.

The facing operation is done (after assembly is complete) by a milling cutter which traverses the entire end of the wing, while the drilling and back-spotfacing is done from a master drill jig which ensures a complete interchangeability.

The attachment between fittings and skin structure (Fig. 8) is by rivets of necessity larger than are typical elsewhere on the surface of the wing. The likelihood of a tension failure across a rivet line is thus greater at the fitting attachment than elsewhere, unless some precaution is taken to thicken the skin there. This was most conveniently done by adding an additional skin layer in this region, attached by adhesive bonding. As a precaution against any unpredictable local effects, the thickness of this additional layer was chosen a little larger than that necessary merely to restore the skin to its original strength, so that the working stress level in this critical region is lower than is typical for more remote regions of the structure. ★

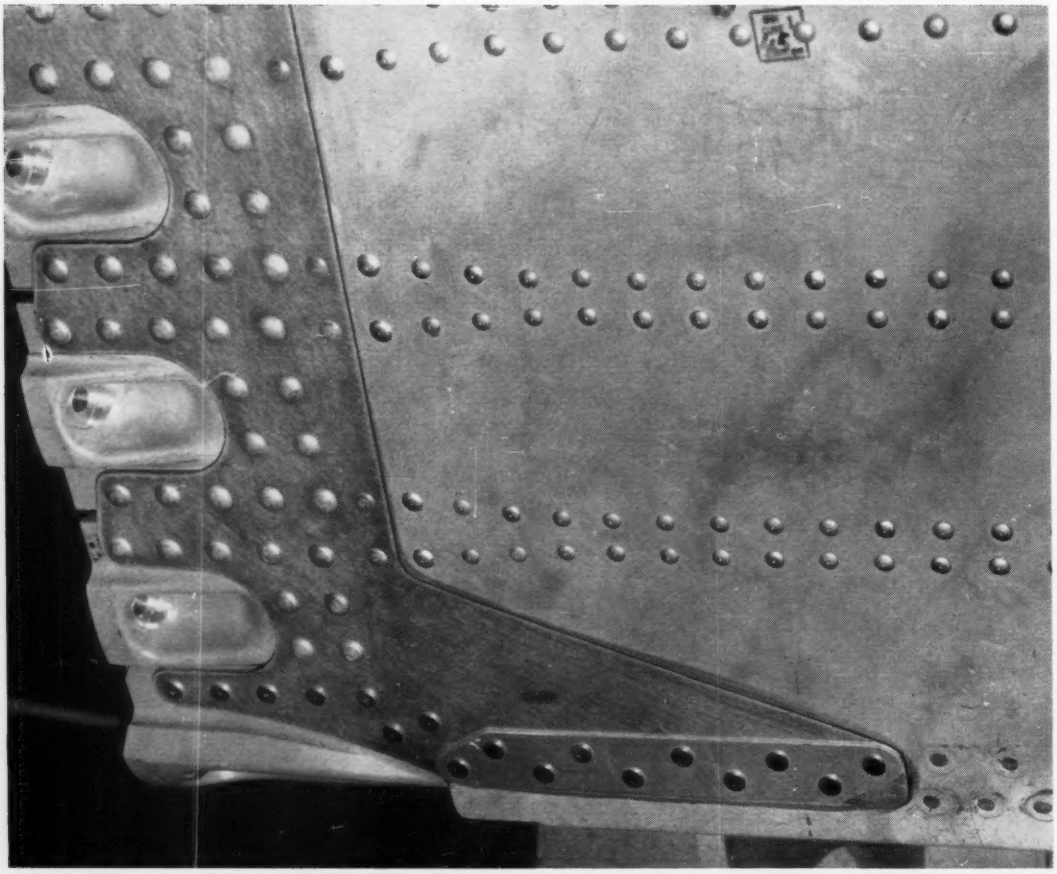


Fig 7. Here you can see the corner fitting and the adjacent bottom surface fittings on the finished product.

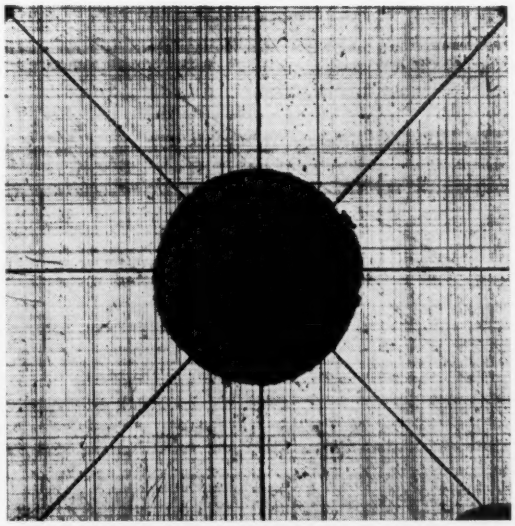
Turning the heat on. Light spring gun fitted with a heater element, is used to apply replica to specimen surfaces.

How to measure local strain—quickly

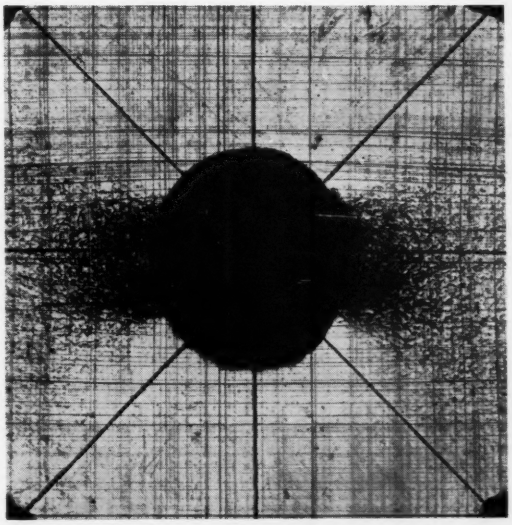
A quick method for the direct measurement of local strain in a structure (or test specimen) under static loading was demonstrated for the first time at the recent Physical Society Exhibition in the U. K.

The technique is to inscribe a light pattern of scratches on the surface of the structure, and to take replicas of this pattern, first with the structure unloaded, and then with it loaded. From the two replicas (compared under a measuring microscope) the relative displacement under load of the inscribed lines can be determined, and the elastic strain deduced to within 0.005 % in a 2-in. gauge length. Plastic deformations over a small area can be fully explored using gauge lengths of about .01 in.

This replica technique (devised by the structures department of the Royal Aircraft Establishment) was originally developed to investigate plastic deformation near a stress-raiser or to find the manufacturing stresses in an aircraft structure. In that case, replicas are taken on sheet components, before and after building them into the aircraft structure, and also after the structure has undergone manoeuvring loads. The technique can also supplement the use of strain gauges during static tests (in a matter of minutes) and be used for the measurement of creep in heated aircraft structures, by taking replicas before and after the heating is applied. Another use for the replica technique is to measure the permanent deformation of a specimen under a lengthy fatigue test. This is possible without removing the specimen from the test machine. ★



Before (above) and after application of tensile load.



Microphotographs taken from hole replicas in test strip.

J. S. Johnston
Cockshutt Farm Equipment Ltd.

Recently, J. S. Johnston, chief engineer, Research Div., Cockshutt Farm Equipment Ltd., gave a lecture before the Hamilton Branch of the Canadian Welding Society. His subject: "Strength considerations in farm implements."

Some of the points raised were so important that we asked him to prepare these six case-histories for you.

Farm implements need strength first

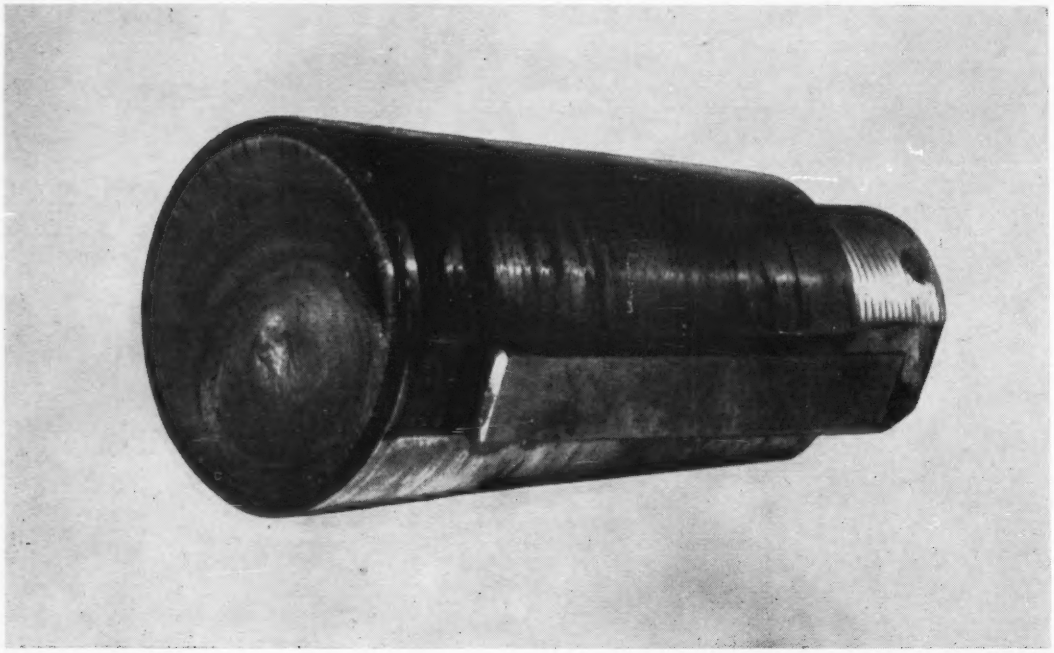


Fig. 1(a)

Case History 1

Fatigue failure of tractor axle

Displacement of the final rupture area from the shaft centre indicates a nominal stress about 10% above the endurance strength of the steel (Figs. 1(a) and (b)). The faint ratchet marks around the periphery show multiple starting points for fracture and indicate that a fairly high stress concentration exists. The beach marks are characteristic of service fatigue failures and point to a variation in applied loads during the failure period (progression of crack).

It was concluded that failure was caused by the small fillet radius [beside fracture in (a)] needed to accommodate a mating roller bearing. Correction for this would be to use a larger fillet radius, a stress-relief groove, or hardening of the fillet by cold work or heat treatment (assuming that the shaft could not be increased in diameter because of the mating parts in the assembly).

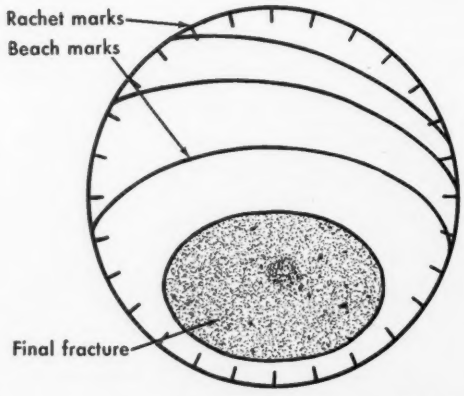


Fig. 1(b)

Case History 5

Photo-elastic study of cast-iron bearing bracket

This bracket supported a shaft which carried a heavy bending load. Figs. 5, 6 and 7 show models made of plastic for determining the stress concentration using a polariscope.

Fig. 5 shows the cross-section of the original shape which was not sufficiently strong; the model shows a fringe order of 4+.

Fig. 6 shows the improvement resulting from a thicker wall, to reduce the deflection of the ring-shaped bearing. The flat side (which appears incorrect from a design point of view) was to provide clearance for adjacent parts, but the fringe order showed an improvement of only 25% in strength.

Fig. 7 shows the final shape, with an increased wall thickness for the ring and a larger fillet radius. The stress was reduced to less than 50% of the original and the design adopted. What may appear to be a slot in the ring was the opaque loading fixture used in the polariscope. The shaft is, of course, completely surrounded by bearing material.

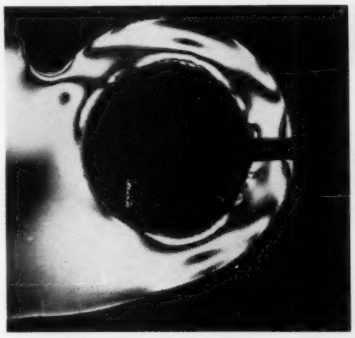


Fig. 5

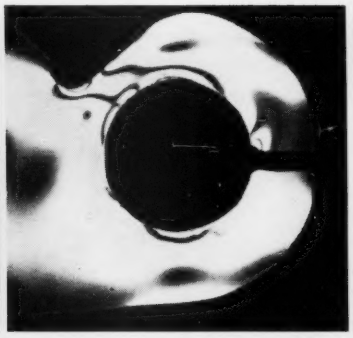


Fig. 6

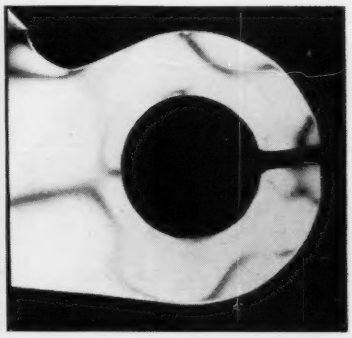


Fig. 7

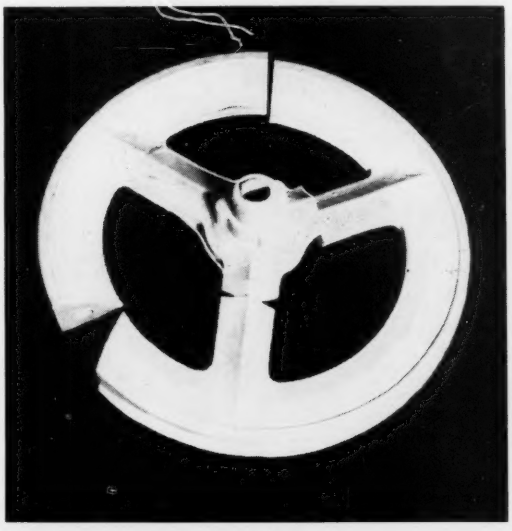
Case History 6

Harvester combine sheave

The cast-iron sheave (below left) had been cracking shortly after casting in the foundry, or during the machining operation.

High residual stress from non-uniform cooling of the casting had been causing failure. In many cases the residual was not sufficiently high in itself but the added stress from machining produced failure.

The curved spokes (below right) accommodate the thermal contractions without introducing high unit strains in the material. An added benefit from the redesign was a weight reduction from 60 to 45 lb. It should be pointed out that previous attempts to reduce cracking by increasing the cross-section of straight spokes probably increased the susceptibility. Cracking might have been avoided by cooling the hub first with an air jet, while the rim was still hot, or by slow cooling the whole casting in a soaking pit.



continued ▶

Case History 2

Rear axle for farm tractor

The portion between the spline and the fillet (arrowed in Fig. 2) was originally of unmachined bar stock. Abnormally heavy loads from special earth moving equipment mounted on the tractor caused failure at the fillet where the maximum bending moment occurred. The fillet radius was limited by the mating roller bearing. A photoelastic analysis showed that a stress-relief groove would increase the fatigue strength by 40%. This was adopted (as shown) and no more failures were reported. In this case, the strength was increased by removing material.

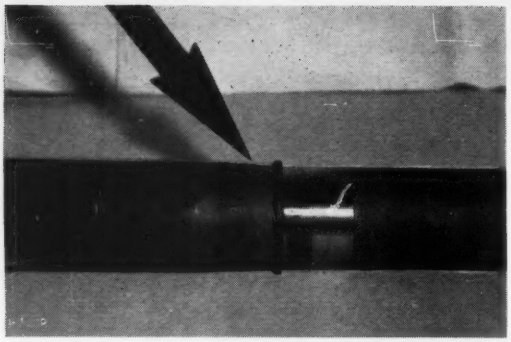


Fig. 2

Case History 3

Spindle assembly for farm tractor

It was desired to increase the strength of the king-pin in this assembly (Fig. 3) without increasing its diameter. The pin (originally carburized) failed in the region shown by the arrow by fatigue under extreme bending loads during lumbering operations. Induction hardening so increased the strength that the part was then satisfactory. A stress analysis on a similar part using strain gauges and the sectional strain relaxation method indicated a compressive residual stress of 41,000 psi in the longitudinal direction, which would largely account for the increased strength of the part.

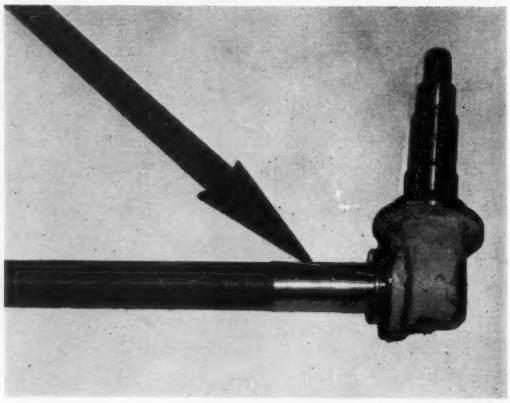


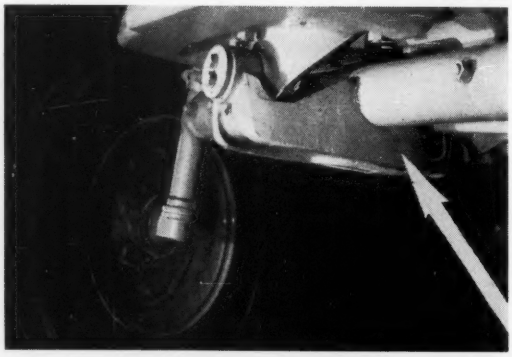
Fig. 3

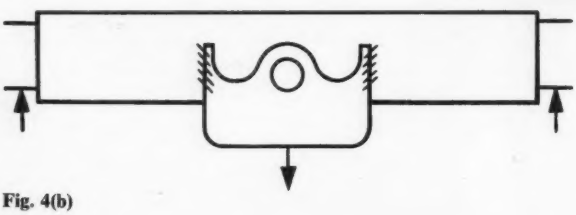
Fig. 4(a)

Case History 4

Front axle assembly on farm tractor

Figs. 4 (a) and (b) show a tubular axle welded to a steel casting subjected to high bending loads. To increase the strength of this assembly, the weld bead was shortened (as shown) from the original all-round welding and applied near the neutral axis. The extreme fibre on the bottom of the tube, (subjected to tensile stress from beam loading) does not suffer from the notch effect of the weld bead. The stress concentration factor of the weld bead is almost 2. By avoiding the weld, therefore, the fatigue strength is doubled. ★





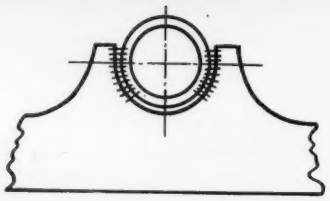
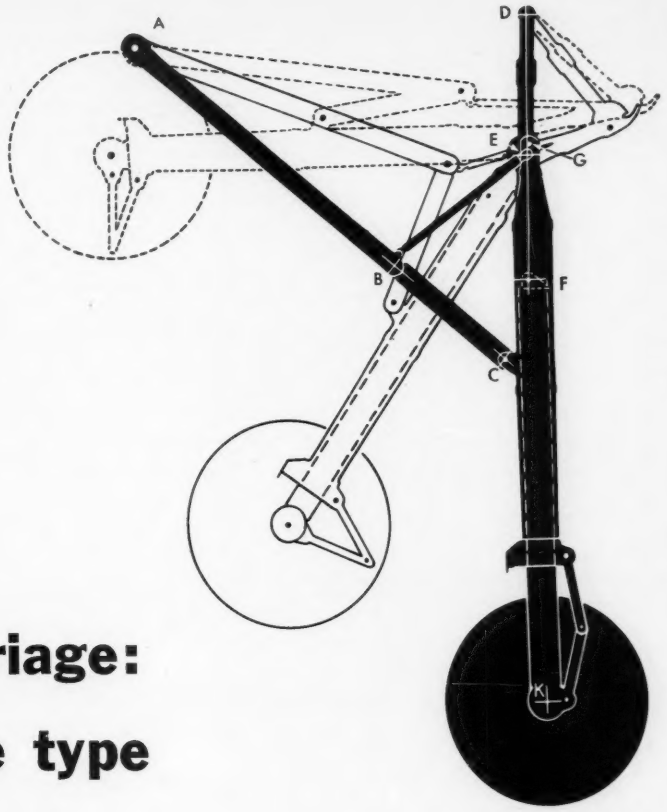


Fig. 4(b)

Fig. A1



Caribou undercarriage: a capsule type shock strut

S. Gyurik *Jarry Hydraulics*

Design problems aside — the varied operating conditions of the Caribou demanded great care in the selection of materials, packings, finishes

The specification for the De Havilland Caribou DHC-4 calls for a tricycle landing gear, fully retractable and able to operate from unprepared fields.

To cater for severe centre of gravity changes (and the pitching caused by braking) it was decided to use 2-stage shock struts on the main and nose undercarts. This results in a stable floor during taxiing and for loading from a truck. The system pressure for all hydraulic units is 3,000 psi.

A requirement from De H called for different size wheels to be fitted, without modifying the shock strut. This is done by using one-piece axles separate from the shock strut, changeable for the different wheel sizes used. It is unnecessary to remove the gear from the aircraft to change axles.

The brakes are bolted to brake spools, which transmit the brake torque directly to the landing gears. This allows the axle to transmit only bending and thrust.

Main gear geometry. Because the Caribou is a high-wing aircraft, it has to have a long gear. This, in itself, created the biggest mechanical design problem; that of stowing the gear in a restricted space.

The dimensions of the nacelle require the gear to be shortened 18.40 in. and because of the large diameter of the wheels (which have to stow completely inside the nacelle) the gear must fold into a very flat position, without fouling the wing torsion-box.

When considering the problem, it was decided not to compress the shock strut (which has a stroke of 90 in.) to achieve this shortening, for this would mean storing energy in the strut during flight, a highly dangerous

continued ▶

practice and one which is bad from the point of view of static fatigue.

It was decided to approach the problem in a novel way, by having a shock strut of the capsule type, sliding inside the main structure of the gear. Because of the large amount of shortening, it was necessary to pass the capsule through the top of the main structure of the gear. It was done like this:

When the main gear is locked down for landing (Fig. A1) the vertical loads are taken through the shortening link DEF and not through the Main Structure of the undercarriage. Side loads are taken out in the Main Structure and fore-and-aft loads through the drag stay ABC and the Main Structure.

When gear retraction is selected, both the retraction actuator (not shown) and the shortening link DEF are pressurized. The shortening link (which is the down lock for the whole system) cracks through a cam mechanism and, pulling the stabilizer BE, folds the drag stay ABC, as shown.

Note how the shock strut capsule FK is drawn up inside the Main Structure.

Nose gear geometry. The nose gear geometry is extremely simple. Space considerations allowed a telescopic drag strut to be used, but the short wheel base and nose shape necessitated an arc folding gear.

The nose gear is equipped with the Jarry steering system, so the aircraft can pivot about one main gear. The steering and damping unit is completely contained in the steering cylinder.

The three major sub-assemblies of the nose gear are: the shock strut, the steering actuator and the telescoping drag strut. For simplicity, the drag strut fulfills several functions. Primarily, it transfers fore-and-aft landing loads to the airplane structure, the loads being transmitted through an internal lock in the drag strut. Through a telescoping action (similar to that used in the main gear) the drag strut shortens to retract the nose gear into the nose bay. A second internal lock secures the gear in the up position.

Nose gear mechanical details

The two-stage strut configuration is common to main and nose gears. The construction features are the same, but the sizes and the operating pressures vary to cater for different loading conditions.

Whilst the most common type of shock absorber consists of one air chamber and one oil chamber, it was necessary on the Caribou (in order to achieve the "stable floor" condition) to provide two air chambers and one oil chamber, and, by choosing the compression ratios of the two air columns, minimize the variations in shock absorber closure over the whole range of static loads. This is achieved by making the static range coincide with the steep part of the first air spring curve, so that large variations of load correspond to small variations of shock-absorber closure. As an example, the nose-gear shock strut has a compression ration of 13:1 in the first (or low pressure) stage and 3:1 in the second (or high pressure) stage, with initial inflation pressures respectively of 40 psi and 700 psi.

The energy absorption capacity of these struts is high, since the limit vertical velocity of descent is 14.5 fps and the limit maximum vertical reaction factor 2.3. This gives a strut stroke of 17.5 in. on the nose gear (19 in. on the main).

In order to achieve the high efficiency implied by these values, it was decided to develop an inverted type of strut for this application. The inverted configuration (Fig. B.1) consists of the two air chambers [the high pressure (1) and the low pressure (2)] at the bottom of the strut [separated by a floating piston (3)] and the oil chamber (4) at the top [separated from the first-stage air chamber by another floating piston (5)]. Inflation of the two air chambers, and position of the second stage floating piston, is achieved through a telescoping stack tube (6). By separating the air and the oil in this way, emulsion (present in the normal type of shock absorber) is eliminated, thus providing for higher efficiency and much better taxiing performance. However, even with the inverted type of strut, it would have been impossible to achieve an efficiency of about 92% without a metering pin (7), the unusual shape of which is caused by the rapid change in air pressure during the transition from 1st to 2nd stage.

The landing energy is dissipated by metering the flow

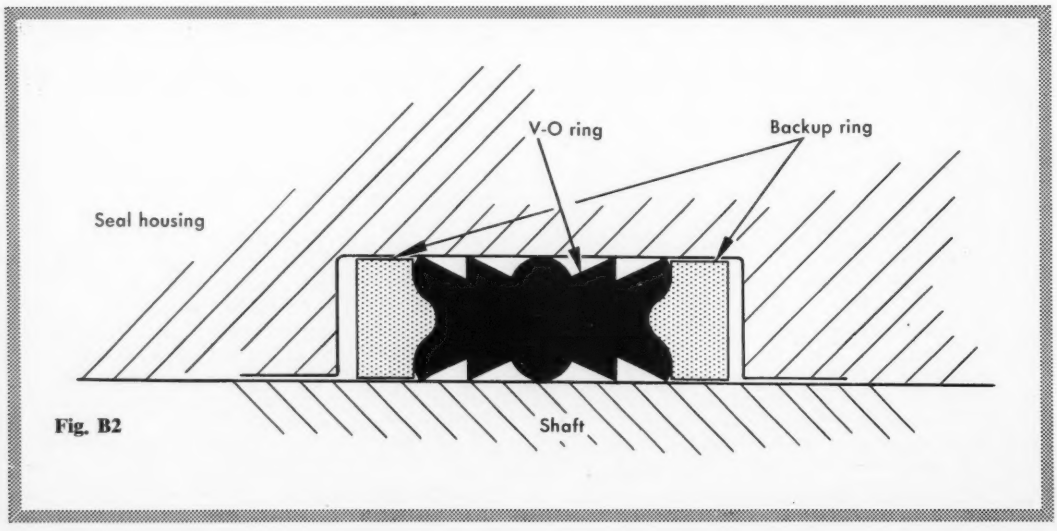


Fig. B2

of oil through fixed orifices (8) in the piston head (9) and through the variable annular orifices (9) provided by the metering pin (7) passing through a bushing in the piston head.

Because of energy stored in the compression cycle in the first and second air chambers, positive rebound control is provided. This is done by the rebound ring (10) which restricts the flow of oil from the annular volume between piston and cylinder during the down stroke of the piston. Additional rebound control is achieved by a flapper valve (11) partially blanking off the fixed orifices (8) in the piston head during the down stroke.

The piston is guided in the cylinder by two linear bearings: the upper bearing (12) is fixed to the piston head (and moves with it) and the lower bearing (13) is fixed at the bottom of the cylinder.

Bearing spacing (and the extended position of the wheels) is controlled by a spacer tube between the two bearings. The spacer tube (in the nose gear) is made up of two parts with mating cam profiles to provide a centering action after the wheels leave the ground, since the nose gear is steerable and can caster.

Detail design

Since the Caribou will be called on to operate from rough unprepared fields, and in temperatures ranging from —65 F to 160 F (with an absolute minimum of maintenance and servicing) great care had to be exercised in the selection of materials, packings and protective finishes, to achieve optimum reliability and trouble-free operation.

Long-stroke shock absorbers carrying bending loads are prone to piston seal failures, especially if O-rings are used. This is due to the rapid reversal of fore-and-aft load on the strut during landing and taxiing. A survey showed one of the most promising types of ring for this application was the Parker V-O ring, a combination of the O-ring and the old V ring (see Fig. B2). Spiral failure (often encountered with O-rings) is almost impossible with this type of ring. A special back-up ring had to be developed, however, to support the fine V-edge of the ring. This seal functions as a combined linear and rotary seal in the nose gear (because of the steering) and as a linear seal in the main gear.

The seals are packed in GE Versilube G.300 silicone base grease, whilst the sliding members of the strut in the pneumatic portion are coated with liquid molydisulphide.

The lower bearing of the strut is made from 750 aluminum-tin alloy, centrifugally cast to eliminate porosity. This material gives very good bearing characteristics for a very low weight. The upper bearing is manufactured from a laminated phenolic tube, which gives a very low coefficient of friction, low weight and good bearing characteristics.

The oleo leg is a fabricated design using a small forging for the axle housing and a length of tube. These two items are welded together by the submerged-arc process (as explained in DE, March 1957). This method of manufacture has a two-fold advantage. Firstly, it enables the rather difficult machining of the stack tube housing to be done without the long tube in place, and secondly, from the economic aspect, only a small forging is required, thus reducing die costs, and the problem of laps in the highly stressed portion of the leg.

To obtain good seal-life, surface finish is of great importance, so all sliding surfaces in contact with seals have a surface finish of 8-16 micro-in. Steel parts are chromium plated to a minimum thickness of .002 in. to give good wear and corrosion properties. ★

Two-stage shock strut arrangement

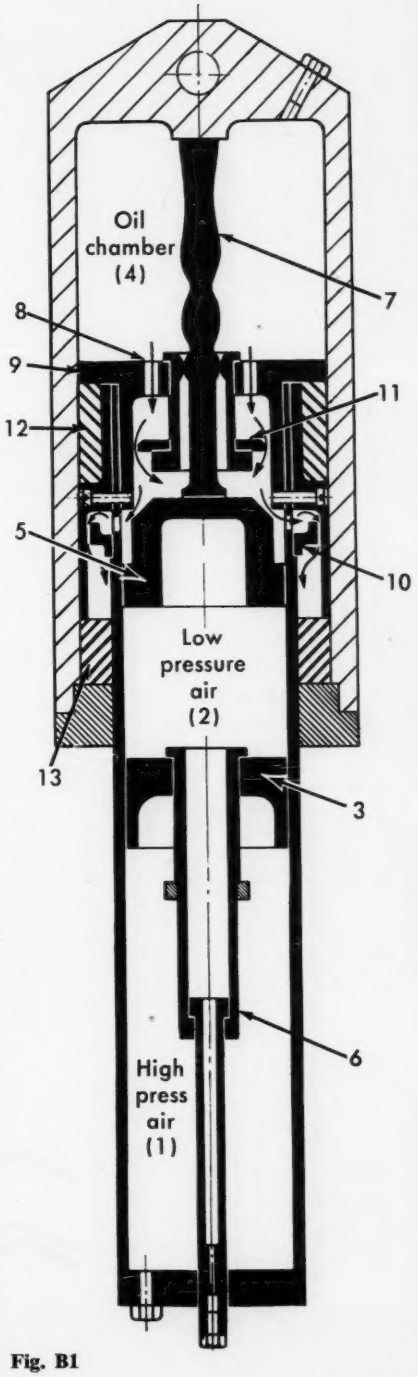
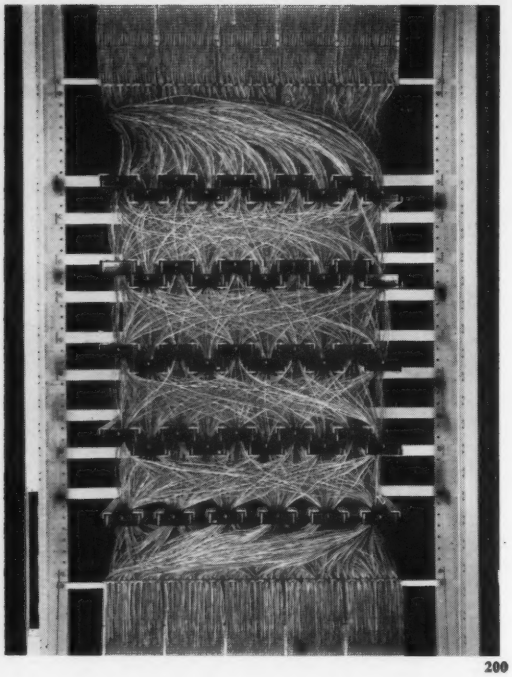


Fig. B1

Design news in pictures



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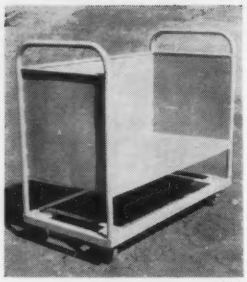

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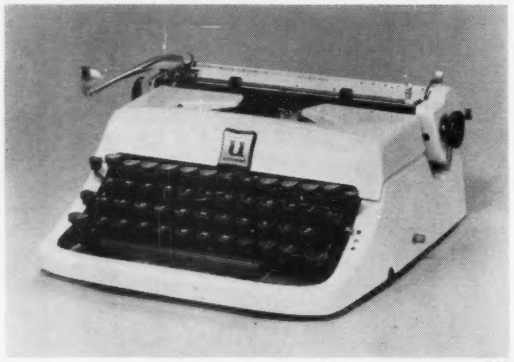

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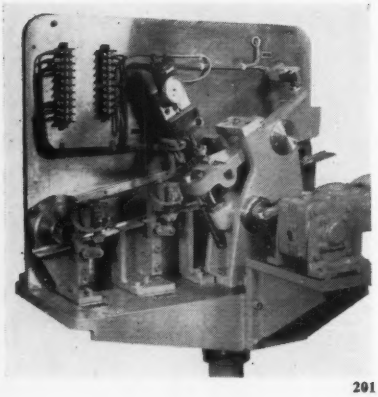

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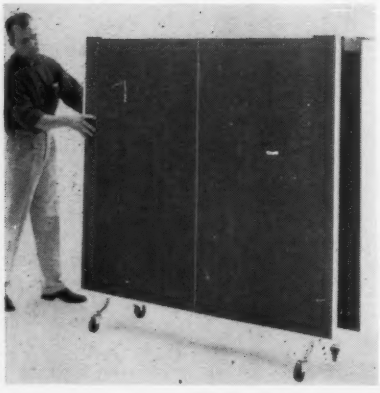
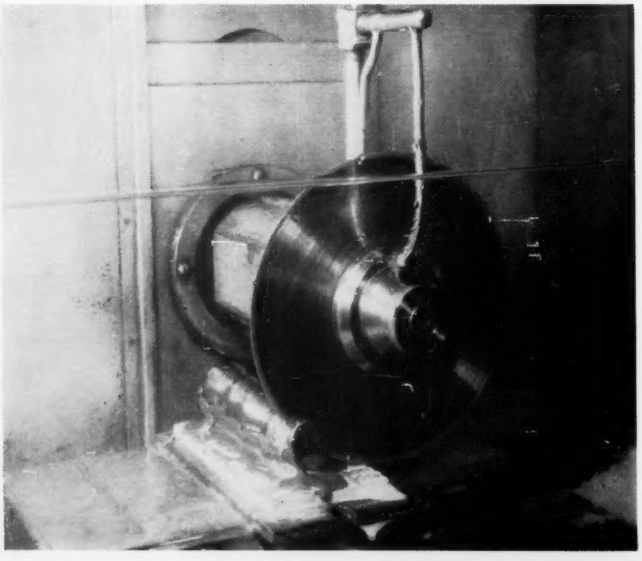
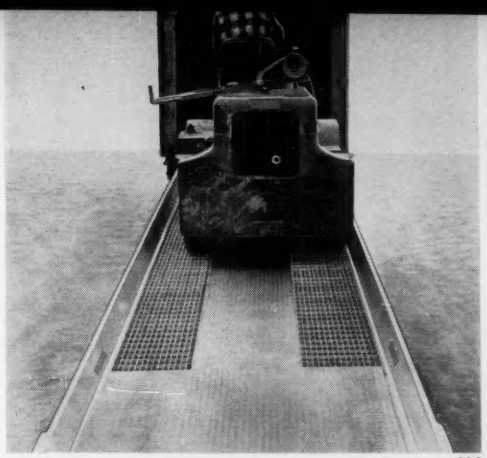


200—Wiring field of ring translator was built to see if 2,000 wires could be used in the unit. 201—Inoffensive looking but it makes short work of gear sorting. 202—Dandy idea for recreation rooms—a folding ping-pong table. 203—Canadian light-weight box truck will handle 1,000-lb loads. 204—Re-designed portable typewriter by Raymond Spilman features a scalloped frontal appearance. 205—Tough as they come—this diamond cut-off wheel cuts hardened steels with great accuracy, say the makers.

205





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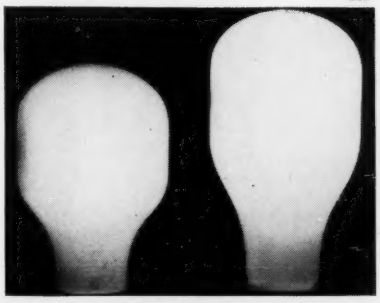
208

Three ways to get off the page . . . three new lamps to light their way

206—Man driving off the page obligingly shows off the non-slip grating of new loading ramp. 207—Open stairs have a roughened, twisted bar surface: can be used indoors and out. 208—Fancy forgetting the tail! Not really, but it's one solution when the aircraft is longer than the hanger. 209—Makers say these household light bulbs are first design change in 25 years. 210—Part of new "Forms in light" designed by Paul Mayen uses specially developed, hand blown glass. 211—Variety in fiberglass table lamps.

209



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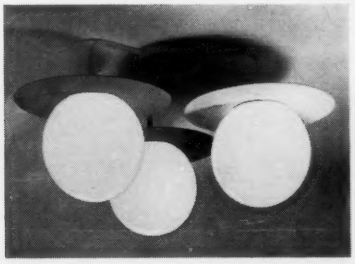

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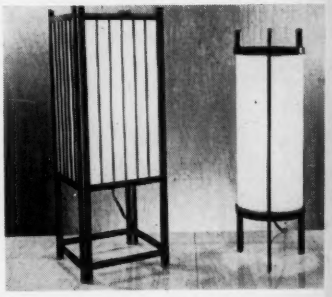
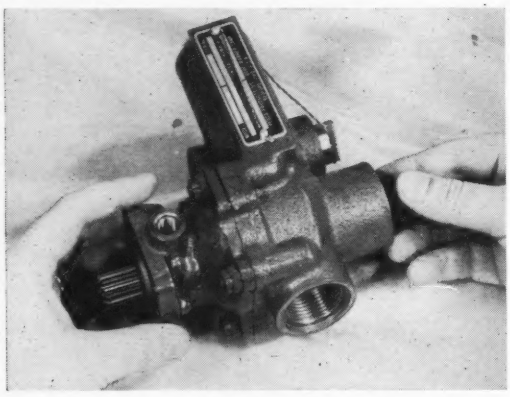


Ideas round-up

Gear pump: with just two major moving parts

Variable displacement gear pumps (with only two major moving parts and automatic pressure compensation) are now available from Pesco Products Division, Borg-Warner Corporation.

The new pump (the VIEP) was designed for use in airborne hydraulic systems, but it is also suitable for industrial machinery and equipment. The low-cost positive displacement units provide the reliability and simplicity of a gear pump, with an efficiency similar to that of a variable displacement piston pump. They are particularly well-suited for high-speed, elevated temperature operations.



The main pumping elements of the VIEP consist of an internal ring gear and pinion. An integral pressure-sensing device provides automatic pressure compensation, adjusting the pump displacement to meet variations in system delivery. Adjustment for variation in pump delivery is accomplished by a simple linear motion. External linkage for manual or automatic remote control of pump displacement can be provided. VIEP units are available for operation at speeds up to 24,000 rpm, at temperatures up to 500 F, at deliveries up to 80 gpm and pressures up to 3,000 psi. Although designed primarily for use in high-speed, elevated-temperature hydraulic systems, special lightweight models are also available for applications where exceptional performance at high temperatures is not a consideration. The lightweight design sacrifices none of the other advanced features of the VIEP.

The pump is designed for low tooth contact loads, smooth transfer of driving forces, quiet operation and low approach and sliding velocities. The pinion gear shaft is supported on each side by a sleeve bearing. Self-equalizing shoe-type bearings mounted on carriers support ring gear load on the pressure side of the pump.

The gear tooth form used on the VIEP is designed with a low clearance volume. As teeth disengage, the space increases gradually, creating a vacuum into which inlet hydraulic fluid flows at low velocities. This contributes to the excellent filling characteristics and low turbulence of the VIEP. **(212)**

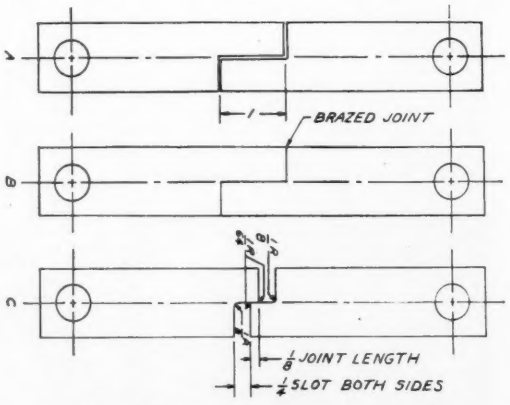
Brazing joints: a call for standardization

A recent proposal was made that the welding industry standardize on a procedure for testing the shear strength of brazed joints.

Earlier in the year, F. M. Miller and R. L. Peaslee (of Wall Colmony) presented a paper at a meeting of the American Welding Society, proposing that a standard specimen, a standard procedure and a standard evaluation for testing the shear strength of brazed joints be adopted. Following presentation of the paper, copies were sent to a select number of brazing authorities, inviting their comments.

Conclusions reached by Miller and Peaslee based on the reported inquiry are as follows:—

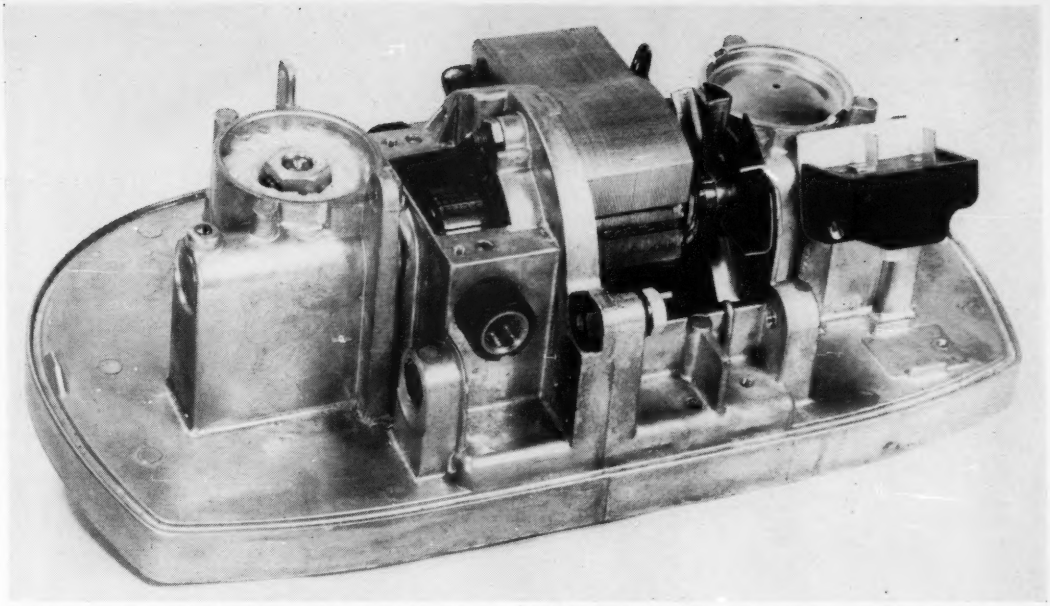
(1) Shear strength data must be used with considerable caution in design engineering work.
(2) Details for the fabrication of test specimens should be included as a standard procedure.
(3) The test specimen design (as proposed) may require modification.
(4) Reproducibility of results is a problem that will have to be a prime target for future investigations.



A. Notched bars before brazing. B. After brazing. C. Slotted after brazing. Material: 1- x 1/8-in. strip

(213)

(continued on page 54)



1. Here are some of the things under the lid. Turret at left is packed with lifetime grease; right, snap-on cover.

DE lays bare a Canadian floor polisher

Appliance design

John W. Dennis

A housewife's tool — you've probably never looked under the lid. If not, you are in for a few technical surprises

There is probably no labor-saving device available to the housewife of today which takes a greater edge off pure physical labor than the electric floor polisher. Externally, at least, the various makes and models exhibit a sameness which tends to make developments in their design pass unnoticed.

Concealed under their simple hoods, however, lie the products of many hours of research and the answers to some tricky problems in design engineering. The Model 5452 Hoover dealt with in this article is an excellent case in point.

Starting with this issue, Design Engineering intends to bring to its readers some of the inside information on everyday items such as this polisher which, by very reason of their ordinariness, go unnoticed in the shadow of more glamorous engineering projects. Most of them retain designs which are relatively changeless due to the thorough design research which they saw originally and alter only in the face of newly arrived methods and materials. A few start on a clean-swept drawing board and owe little to previous work in the field. The polisher under discussion falls into the first of these categories. It is based on a design which is several years old and which originated in the United States (with Hoover)

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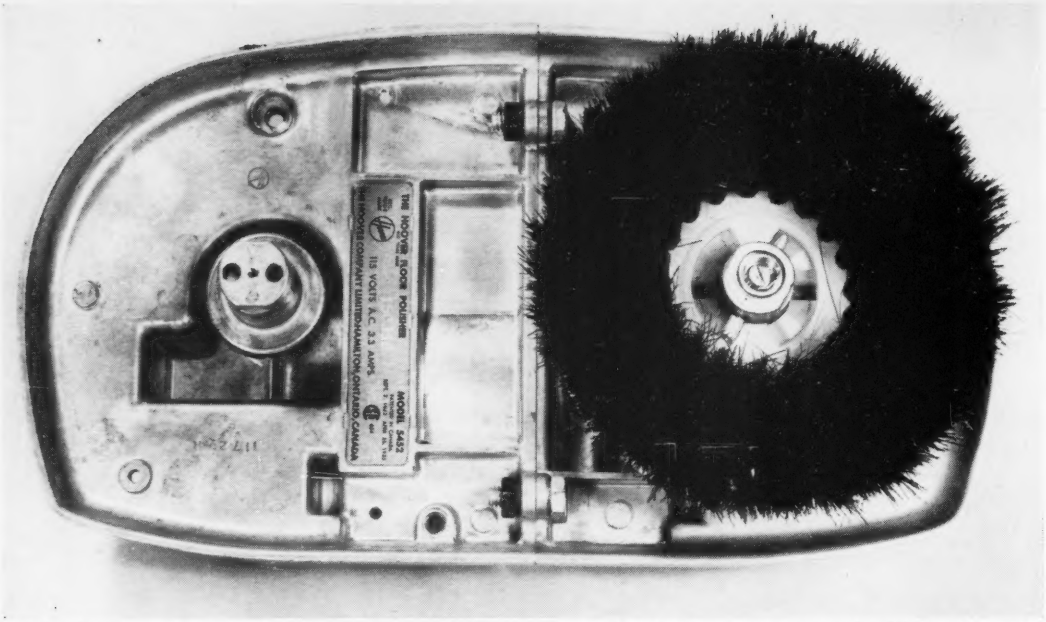
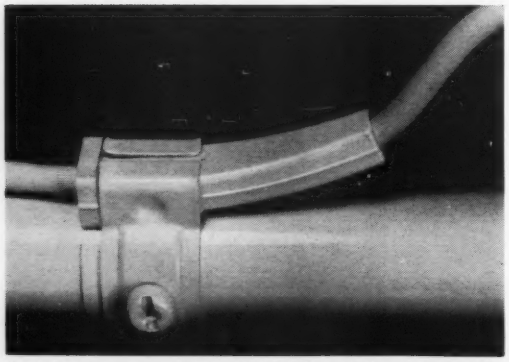
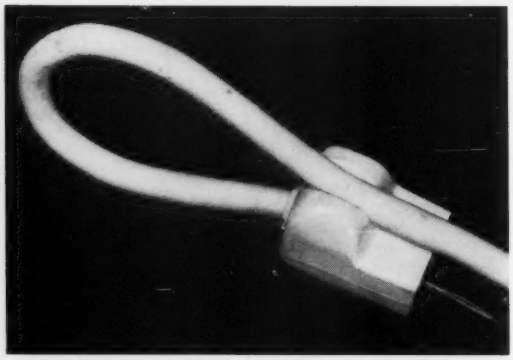


2. One brush removed to show worm gear shaft. Polisher has indented silhouette to get under kitchen toe spaces



3. Close-ups shows the vinyl strain-relief cord protector



4. Another close-quarters shot shows vinyl clip-on plug

and was patented in Canada as far back as 1943. It was designed for the Canadian market.

The external appearance of the appliance is shown in Fig. 9 and is dominated by the coral-colored hood. This is made in the U. S. from flame-resistant Tenite acetate (a plastic from Eastman Chemical Products Inc.) and the color, of course, is molded in. The pliable furniture guard which runs round the base of the hood is of pvc (elastomeric) in a semiflame finish and with a durometer hardness 65/75. The indented silhouette of the hood allows the polisher to reach into toe-spaces such as found under kitchen cupboards. The medallion is fastened at three points (see Fig. 6) by tongues pushed through the hood and twisted a half turn. Fig. 6 also shows the three points where the hood fastens to the die-cast aluminum housing. Bolts come up through the base of the housing into small rectangular plates which are in turn attached to the hood with self-tapping screws. The slits visible in the hood allow for the exit of the bail arms, the electric cord and the foot lever which releases the handle of the polisher and starts and stops the motor.

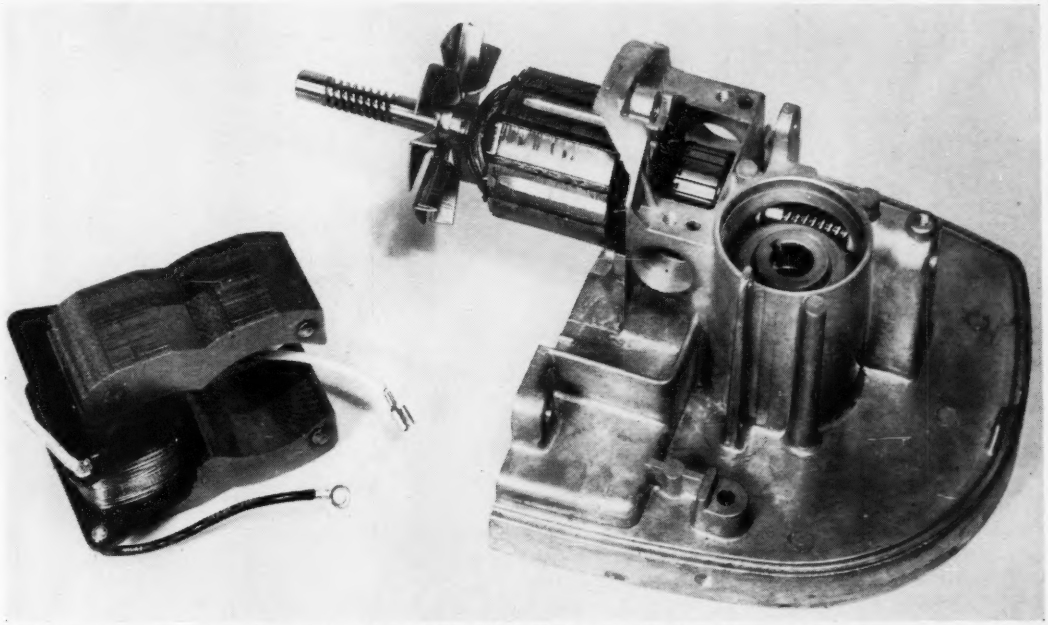
Two interesting features of the design that can be seen from the outside are: the vinyl strain-relief cord protector (Fig. 3) and the clip-on plug (Fig. 4) which can be snapped back onto any strand of the polisher's lead when it is wound up on the handle for storage.

The diagrams on the facing page explain clearly much of the design of this machine and the photographs serve as a supplement. Fig. 1 shows the gear housings, one with its snap-on lid removed and uncovering the worm gear packed with lifetime grease. The hardened steel thrust screw is just visible to the left of this. The brush holder is made in the U. K.

Fig. 2 shows the underside of the polisher with one

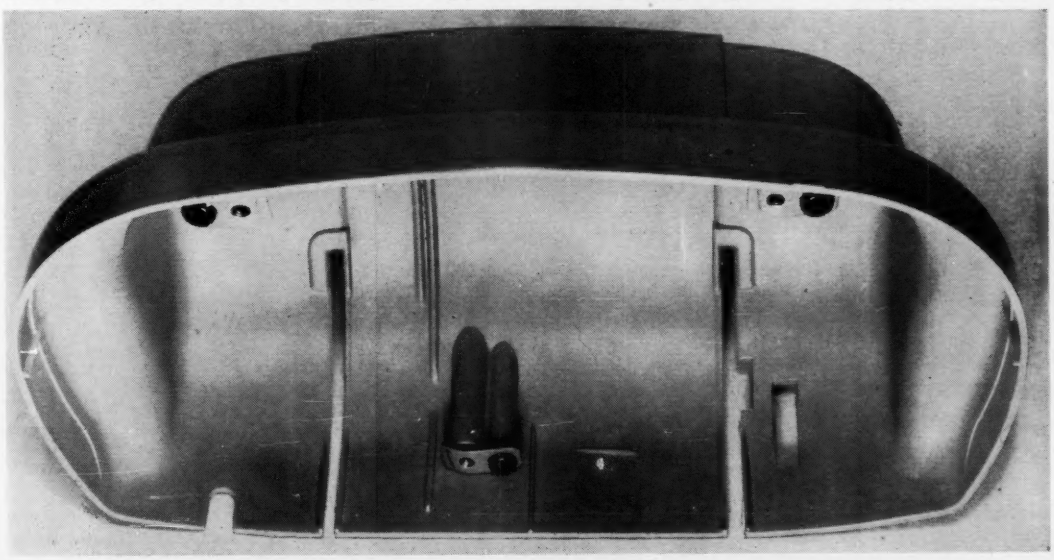
of the polishing brushes in position. These snap on to the bottom of the worm gear shaft by means of a simple device of spring loaded pins which is bolted to it. The brushless shaft has had this device removed in our photo. Two of the hood-retaining bolt holes are visible.

The photograph in Fig. 5 shows the machine broken down still further. The worm gear (no longer grease-covered) is powder-metal formed, including the keyway —only the teeth have to be cut later. The ventilating fan is a Hoover stamping and the cutting and flame-hardening of the worm next to it is the work of the company too. Balance slots are cut into the rotor laminations and the slots are wedged with paper rope on an automatic machine. The work of another automatic machine can be seen in this shot, namely the slots in the commutator. The terminal on the white jacketed lead is of the push-on/pull-off type and specially designed to



5. These are some of the vital parts in the polisher that help to put the gleam in your floor: most are Hoover made

6. Hood not only does a job of enclosing working parts, but has a pleasing design. Note the deep furniture guard.



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resist the vibration it undergoes.

The polishing brushes themselves have been the object of some thought at the desgn stage (Fig. 7). The bristles, which are of Tampico fibres, are stitched into a brush base of Styron 475 which has the advantage over wood of being able to shrug off repeated hot water washings without any deterioration. An interesting sidelight on the bristles themselves is the fact that they are bevelled so as to be slightly shorter at the centre of the brush. The weight of the polisher splays the outer bristles and thus brings all the bristles to bear with near-equal pressure on the surface being polished. The hole and channels in the Styron base fit over the spring-loaded pins at the bottom of the worm gear shaft and make a firm connection merely by pushing on and turning through about 45 deg (see also Fig. 2).

The mating half to the polisher housing in Fig. 5 is shown in Fig. 8 in its as-cast state. Hoover die-casts these housings themselves at their Hamilton plant. The alloy has the ASTM designation SC84B. The thin channel running round the edge of the casting serves to retain the furniture guard shown on the assembled polisher in Fig. 9.

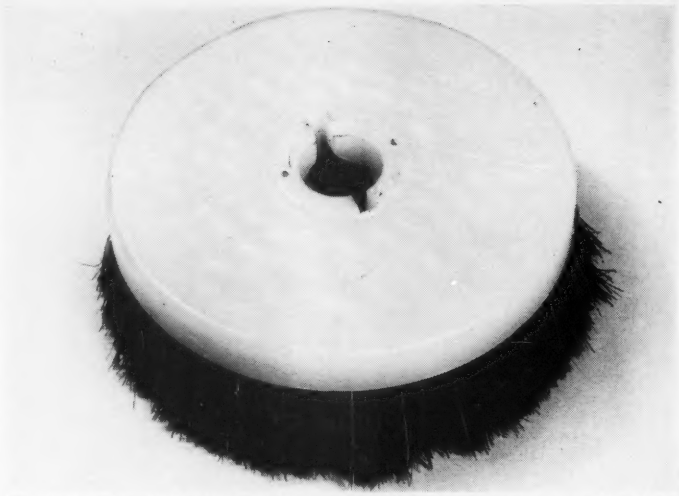
Handle is the switch

One of the distinguishing features in the design of this polisher is the on-off mechanism which is incorporated with the mechanism that releases the handle. This is best seen from the diagrams shown earlier. Pressure on the foot pad (46) disengages a pin which releases the bail arms and allows the handle to fall back towards the user. In doing so, a cam on the opposing arm drops away from a switch button (33) on a spring-loaded snap switch and the electrical connection is made. Swinging the handle up reverses the process and the motor ceases to drive the brushes as the handle engages in a vertical position.

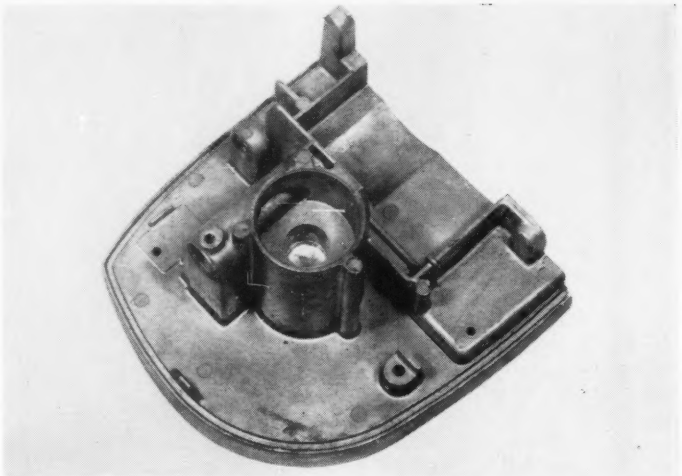
The tubular handle is in two parts, and the through-bolted clamp that joins these also serves to hold the strain-relief cord protector at the point where the cord leaves the handle (Fig. 3).

Space forbids an exhaustive discussion of the design features of this appliance but many more of those not discussed should be apparent in the accompanying diagrams. There is more to a floor polisher than an electric motor and brushes: it calls for detailed and imaginative design engineering. ★

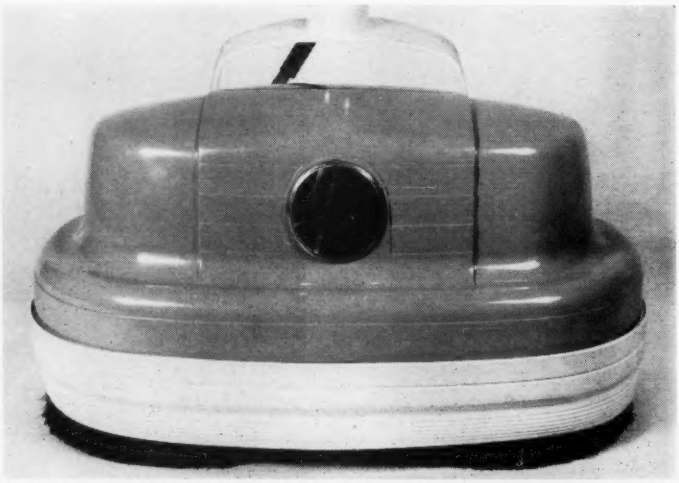
CREDITS—Design Engineering wishes to thank the Hoover Co. Ltd. of Hamilton, Ontario, for their close co-operation in the preparation of this article—in particular Mr. F. D. S. Marrett, chief engineer with that company.



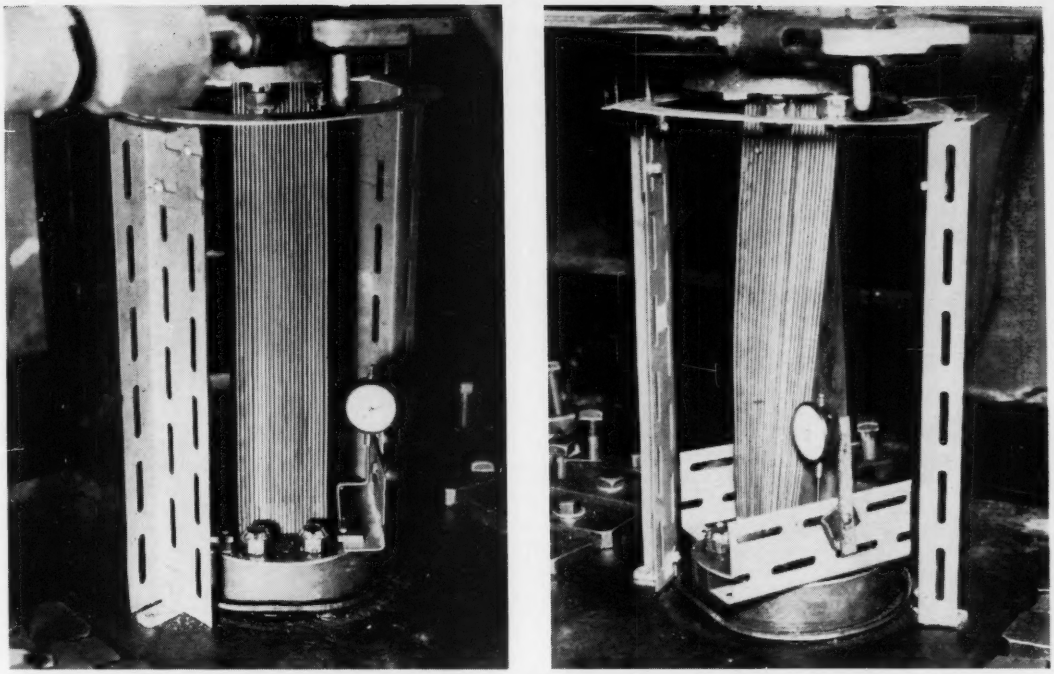
7. Styron brush base: bristles are bevelled (read text opposite photo)



8. Hoover die-casts these housings at their Hamilton, Ontario plant



9. At the end of it all you're face to face with a Canadian floor polisher.



At left pack mounted in rig for static tests. Photograph right shows the pack in maximum twist position. Designed and manufactured in Canada, 22-leaf laminated torsion bar generates torque of 84,500 in. lbs at 63 deg. twist.

Tight space? Try fasciculated springs

Clustered torsion springs occupy less space than suspension springs. But there's more than that to splitting the suspension load, study shows.

S. Mordasewicz *Army Development Establishment*

Object of this study

In the field of independent suspension for multi-wheeled vehicles, the main difficulty is: how to house the springs in a confined space.

This article studies the possibility of using the laminated torsion-bar spring to reduce the space taken up by a suspension spring, without forfeiting its flexibility. It shows how to analyse springs (for use when space is limited) that are simple in design, cheap to manufacture and easy to install, and how to establish basic formulae for designing to certain spring characteristics.

Outstanding examples of the use of laminated torsion-bars in front suspensions are: the **Volkswagen** and the British Lanchester **Leda.**

The weight of a spring for a given maximum stress is determined by the energy it can absorb and store, an ability which is the measure of its efficiency. In this particular problem, the over-all volume of the spring and its flexibility (not the volume of the spring material) are the prime considerations. Thus, the initial requirements preclude the use of any material but steel, and eliminate various spring types.

For example, the most efficient springs (tension bar and thin-walled torsion tube) are unacceptable because of manufacturing difficulties. Helical and volute springs waste too much space (for they enclose a relatively large core) and the leaf spring is the least efficient type. The solid torsion bar is thus the only logical choice of spring element.

The permissible maximum stress, and the required rate of deflection, determine the operative length of the torsion bar. The length of solid bar for this problem is found to be quite considerable and rules out its use for space considerations. The only solution is to split the load, and replace the single torsion bar by a number of bars of smaller section and correspondingly shorter length.

The component bars of such a fasciculated (clustered) torsion spring may be disposed either in a spaced

continued ▶

or a contact pattern and their cross-sections may assume the form of any geometrical figure.

The most efficient solid torsion bars are of round-section, but the only way of fixing their ends is by expensive-to-machine splines or polygon shaped ends. Furthermore, the addition of fixing stresses, to those imposed by the pure torque makes it necessary to upset the ends of round section bars, in order to keep within the limits of permissible stress.

Round bars thus cost more to manufacture (and to anchor) than equivalent bars of regular polygon section, in which the fixing stress is a maximum at the corners while the torque stress is a maximum at the centre of the flat sides. Hence, at no point are the two maximum stresses compounded, so the bars may be of constant section. This means that they can be produced economically by rolling and drawing. They can, moreover, be closely packed in bundles of polygonal shape, which call for comparatively simple and inexpensive anchorage of the ends, due to the locking action of interfacial contacts.

The ability to pack into a solid bloc considerably narrows the selection of bar sections, because the only regular polygons that can fill space by iteration are quadrilaterals, triangles and hexagons.

Each of these sections is characterized by its degree of torsional efficiency, for in bars of symmetrical, non-circular cross-section the greatest intensity of shear stress occurs at points on the perimeter nearest the axis of twist. In short, the stress is not proportional to the distance from the centroid of the cross-section. The theory of torsion of circular bars cannot therefore be applied in this case, and the results of numerous investigations of the problem have been summarized in well-known approximate formulae, deduced by different authorities for each shape of non-circular cross-section. Some of the formulae (relating to cross-sections that can fill space by repetition) are on the Data Sheet, both in their original and homogeneous forms, that is, when expressed in identical terms. For the purpose of this study, a compounded formula for each section was determined by interpolation. When equated with a similar formula for a solid round shaft, this gives the relative torsional characteristics of the section.

The results of tabulation are expressed in percentage figures, the 100% mark being allotted to a circular bar. They are based on the assumption that the torsional modulus of elasticity, the active length and the cross-sectional area are identical in each case.

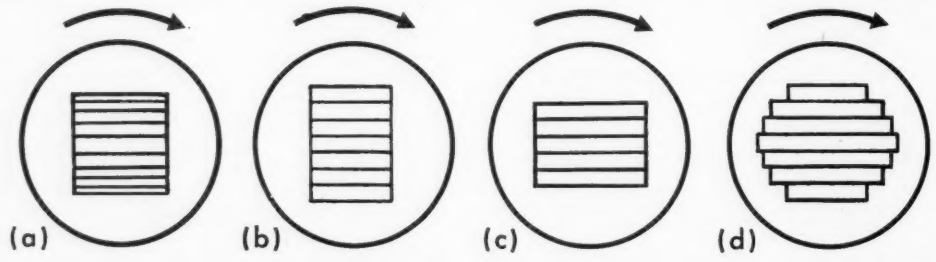
It can thus be seen that, for a given angle or twist, the largest torque can be generated by a hexagonal bar. Although its angular deflection (for a given maximum stress), is about the same as for a triangular or square bar, its over-all efficiency is the highest among the bars analyzed. A hexagonal cross-section is therefore the logical choice when the spring geometry calls for a high, angular load-rate.

On the other hand, for a given angle of twist, the torsional stiffness of a rectangular shaft is the lowest among the bars analyzed and its value declines rapidly with increase in the width-thickness ratio. For a given maximum stress, however, its angle of twist is the largest and (for a sufficiently high width-thickness ratio) may be several times that of a circular bar. It is therefore the only choice when a considerable angular deflection is required, despite its low specific resilience, which is due to a relatively high proportion of torsionally inactive material adjacent to the corners.

The triangular and square bars thus have no outstanding torsional properties and so do not warrant further study.

Rectangular bars. The most readily available spring material is the standard round-edge flat stock, and compound torsion springs made up of a number of leaves, superimposed on one another, are known as **laminated torsion bars.** Their use extends from hinge springs of some 400 in. lb. capacity, to suspension springs capable of generating a torque around 100,000 in. lb. No general theory on their characteristics is as yet available.

Recently, however, a comparative study of torsion bar application to an independent suspension unit for military vehicles was conducted in Canada. One of the design versions consists of a laminated torsion bar located on the axis of oscillation of the suspension arm,



Comparison between some possible shapes of flat leaf pack, that can be located inside a housing of identical size. It shows:
(a) A square pack, composed of leaves of constant width and graded thickness
(b) A slender pack, containing a relatively large number of equal, narrow leaves
(c) A broad pack, containing a relatively small number of equal, wide leaves
(d) A rounded pack, composed of leaves of constant thickness and graded width

Fig. 1

thus making full use of the potential flexibility of this type of spring.

Preliminary calculations were made on the basis of recorded properties of existing installations, as well as available empirical formulae (like those worked out by Salter & Co. Ltd. for their experimental automobile suspension). In actual practice, however, these guiding points were of little value because each datum was valid only for a particular spring and application.

Under these circumstances, the actual development process was preceded by some tests of various arrangements, until, by changing the thickness, width and number of laminae, the required performance characteristics were attained. Readings thus recorded provided additional information and it is felt that the whole experimental data available by this time constitutes a sufficient background for an attempt to compute theoretical formulations.

The design of the spring may be greatly diversified. The number, thickness and width of component bars may be varied at will, as shown in Fig. 1, and the inherent damping characteristics may be altered by the degree of smoothness of contact surfaces and by the amount of lubrication. No single rule could take care of so many design factors and, in order to establish a general formula capable of rapid solution, a reduction of the number of variables is necessary, by making the following assumptions:

(1) All leaves have the same cross-section.

This is amply justified by the resulting simplification in manufacturing, assembly and maintenance procedures.

(2) The cross-section of the spring is square.

This shape is the most economical as regards the space required to locate a spring of a given capacity, because the space is determined by the diagonal of the pack.

(3) The number of leaves is equal to their width — thickness ratio.

This is a derivative of previous assumptions.

(4) The end housing cut-outs embody an adequate amount of side and end float.

This provides every leaf with freedom of movement due to twist, to prevent wedging and bowing of the leaves. It avoids undetermined longitudinal stresses, which (in the case of comparatively thin leaves and large angles of twist) may contribute an important portion of the torque.

(5) All contact surfaces are ground, machine polished and constantly lubricated.

This is to eliminate discrepancies due to inequality of surface conditions and to reduce to a uniform level indefinite values of inter-leaf friction, and of friction between the outer leaves and the end housings.

(6) Angular presetting or "scragging" and the use of shims, liners and inserts between the leaves is disregarded.

These methods tend to reduce the angle of permanent set and increase the fatigue life of the spring, but have no signal effect on its elastic properties.

m	K_s	K_g	K_p	K_m
1	.141	.141	.141	.677
2	.487	.97	.99	.980
3	.817	2.45	2.74	1.213
4	1.142	4.57	5.42	1.351
5	1.464	7.32	9.02	1.440
6	1.785	10.71	13.56	1.503
7	2.105	14.73	19.03	1.550
8	2.425	19.40	25.44	1.586
9	2.744	24.70	32.78	1.614
10	3.062	30.62	41.06	1.638
11	3.381	37.19	50.29	1.657
12	3.699	44.39	60.45	1.674
13	4.017	52.22	71.55	1.688
14	4.335	60.69	83.59	1.700
15	4.653	69.79	96.57	1.710
16	4.971	79.54	110.50	1.720
17	5.289	89.91	125.36	1.728
18	5.606	100.91	141.16	1.736
19	5.924	112.56	157.90	1.742
20	6.242	124.83	175.59	1.748

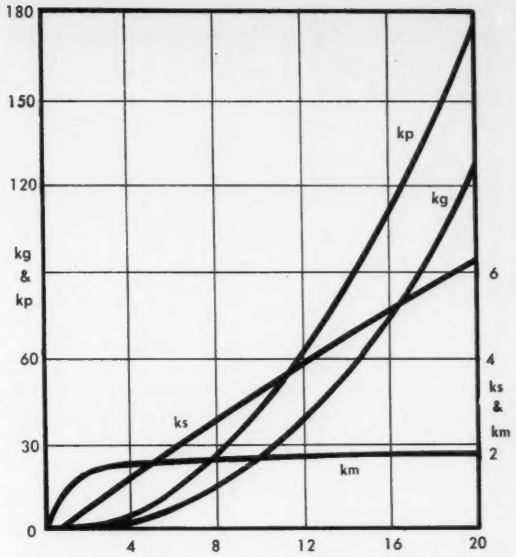


Fig. 2 Functions of Ks, Kg and Kp shown in graph above. Box lower left this page shows numerical values.

THEORY

The torque generated by pure torsion on a single rectangular bar may be put in the general form:

$$T_s = \frac{\theta G}{l} \times b^4 \times K_s \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

A preliminary investigation shows that the coefficient K_s may be expressed by the equation:

$$K_s = Xm - Y - Zm^{-1} \quad \ldots\ldots\ldots\ldots (2)$$

where m denotes the width—thickness ratio of the bar. The solution of equation (2) for significant values of m gives:

$$K_s = .317m - .076 - .10m^{-1} \quad \ldots\ldots\ldots (3)$$

which agrees in general with the Data Sheet.

If we consider now a group of m identical bars, all under equal and purely torsional stress, the total torque generated will be:

$$T_g = T_s m = \frac{\theta G}{l} \times b^4 \times K_g \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

continued ▶

where

$$K_g = K_s m = .317m^2 - .076m - .10\sqrt{m} \quad \ldots(5)$$

If the same bars are, however, arranged one-on-top-of-the-other, and the resulting pack twisted as a unit, the ensuing torque may be expressed in a similar form:

$$T_p = \frac{\theta G}{l} \times b^4 \times K_p \quad \ldots(6)$$

but its value will always be higher than the corresponding value of T_g.

This is due to the structural composition of the pack, for it may be assumed that pure torsion can exist only in the centre leaf of a pack containing an odd number of laminations. All outer leaves of such a pack (and all the leaves of a pack containing an even number of laminations) are progressively subjected to a certain amount of bending, because their centroids become helices and their twist is unsymmetrical.

It follows that the coefficient K_p represents the combined factors of torsional rigidity, flexural rigidity and interleaf friction, as well as of local bending and friction at the driving edges of the leaves. After calculating its values from the experimental data available, it was found that this coefficient may be put in the following form:

$$K_p = Xm^2 - Ym + Z\sqrt{m} \quad \ldots(7)$$

Again, by repeatedly solving simultaneous sets of equation (7) for all current values of m, it was found that the formula:

$$K_p = .471m^2 - .73m + .40\sqrt{m} \quad \ldots(8)$$

generally agrees with the test readings of packs containing up to 22 laminae.

The functions K_s, K_g and K_p are shown graphically in Fig. 2, and some of their numerical values in the Box.

Max shear stress

The value of the maximum shear stress induced by pure torsion in a single rectangular bar may be put in the general form:

$$S_s = T_s \times \frac{3m + 1.8}{m^2 \times b^3} \quad \ldots(9)$$

or substituting the value of T_s from Eqn. (1):

$$S_s = \frac{\theta G}{l} \times b \times K^1{}_s \quad \ldots(10)$$

where

$$K^1{}_s = K_s \times \frac{3m + 1.8}{m^2} \quad \ldots(11)$$

Equation (10) is, of course, valid also for a group of m identical bars, all under equal and purely torsional stress. If the same bars are arranged one on-top-of-the-other and the resulting pack twisted as a unit, the expression for maximum shear stress becomes:

$$S_p = \frac{T_p}{m} \times \frac{3m + 1.8}{m^2 \times b^3} \quad \ldots(12)$$

Or, substituting the value of T_p from equation (6):

$$S_p = \frac{\theta G}{l} \times b \times K^1{}_p \quad \ldots(13)$$

where

$$K^1{}_p = K_p \times \frac{3m + 1.8}{m^3} \quad \ldots(14)$$

S_p is an indicated stress, equivalent to combined torsion, bending and friction.

Equation (13) represents an average maximum stress, namely, the maximum stress induced in two intermediate leaves. The maximum stress in the centre leaf (being purely torsional) is given by Equation (10). The largest maximum stress S_m will, of course, occur in the two outermost leaves, subjected to the most severe distortion of their centroids.

In the absence of any reliable data on the stress differential between the leaves, a linear stress distribution may be assumed to be a satisfactory approximation.

It follows that:

$$\frac{S_s + S_m}{2} = S_p \qquad \text{hence} \quad S_m = 2S_p - S_s$$

or, substituting values of S_p and S_s from equations (10) and (13):

$$S_m = \frac{\theta G}{l} \times b \times K_m \quad \ldots(15)$$

where, substituting values of $K^1{}_p$, $K^1{}_s$ and K_g from equations (5), (11) and (14):

$$K_m = \frac{3m + 1.8}{m^3} \times (2K_p - K_g) \quad \ldots(16)$$

The function K_m is shown graphically in Fig. 2, and some of its numerical values in the Box.

By substituting values of K_p and K_g from equations (5) and (8), the basic formulae for torsion of a square pack of rectangular laminae may be expressed in their general form:

Torque

$$T_p = \frac{\theta G}{l} \times b^4 \times (.471m^2 - .73m + .40\sqrt{m}) \quad .(17)$$

Max. Shear Stress

$$S_m = \frac{\theta G}{l} \times b \times \frac{3m+1.8}{m^3} \times (.625m^2 - 1.384m + .90\sqrt{m}) \quad \ldots(18)$$

It must be borne in mind that, with this type of torsion spring, the end restraints exert a strong influence on the distribution and magnitude of local stress concentrations. The max. stress formula therefore represents only approximate values of indicated stress in areas remote from the end. ★

Design Engineering DATA SHEET

THIS SHEET IS REFERRED TO IN THE ARTICLE IMMEDIATELY PRECEDING THIS PAGE.

EMPIRICAL FORMULAE derived by:		SHAPE OF CROSS – SECTION					
		EQUILATERAL TRIANGLE	RECTANGLE 1:1	RECTANGLE 1:3	RECTANGLE 1:10	RECTANGLE 1:20	REGULAR HEXAGON
TIMOSHENKO in "Strength of Materials"	original form	$\theta=\frac{T\times l}{.6\times G\times Ip}$	$\theta=\frac{T\times l}{.141\times G\times a\times b^3}$	$\theta=\frac{T\times l}{.263\times G\times a\times b^3}$	$\theta=\frac{T\times l}{.313\times G\times a\times b^3}$	$\theta=\frac{(3+1.8\times\frac{b}{a})\times T\times l}{G\times a\times b^3}$	$\theta=\frac{T\times l}{.133\times A\times G\times h^2}$
		$S=\frac{20\times T}{b^3}$	$S=\frac{T}{.208\times a\times b^2}$	$S=\frac{T}{.267\times a\times b^2}$	$S=\frac{T}{.313\times a\times b^2}$	$S=\frac{T\times(3+1.8\times\frac{b}{a})}{a\times b^2}$	$S=\frac{T}{.217\times A\times h}$
	homogeneous form	$T=\frac{\theta\times G}{l}\times.0216\times b^4$	$T=\frac{\theta\times G}{l}\times.141\times b^4$	$T=\frac{\theta\times G}{l}\times.789\times b^4$	$T=\frac{\theta\times G}{l}\times3.130\times b^4$	$T=\frac{\theta\times G}{l}\times6.472\times b^4$	$T=\frac{\theta\times G}{l}\times\frac{h^4}{8.682}$
		$\theta=\frac{S\times l}{G}\times\frac{2.315}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.475}{b}$	$0=\frac{S\times l}{G}\times\frac{1.015}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.631}{h}$
SEELY in "Advanced Mechanics of Materials"	original form	$\theta=\frac{46.2\times T\times l}{b^4\times G}$	$\theta=\frac{7.11\times T\times l}{b^4\times G}$	$\theta=\frac{4\times\pi^2\times T\times l\times Ip}{A^4\times G}$			$\theta=\frac{.967\times T\times l}{b^4\times G}$
		$S=\frac{20\times T}{b^3}$	$S=\frac{4.8\times T}{b^3}$	$S=\frac{(3\times a+1.8\times b)\times T}{a^2\times b^2}$			$S=\frac{1.09\times T}{b^3}$
	homogeneous form	$T=\frac{\theta\times G}{l}\times.0216\times b^4$	$T=\frac{\theta\times G}{l}\times.141\times b^4$	$T=\frac{\theta\times G}{l}\times.821\times b^4$	$T=\frac{\theta\times G}{l}\times3.009\times b^4$	$T=\frac{\theta\times G}{l}\times6.064\times b^4$	$T=\frac{\theta\times G}{l}\times\frac{h^4}{8.703}$
		$\theta=\frac{S\times l}{G}\times\frac{2.310}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.481}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.015}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.045}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.071}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.537}{h}$
WILSON in "Practical Solution of Torsional Vibration Problems"	original form	$d^4=\frac{b^4}{4.53}$	$d^4=1.43\times b^4$	$d^4=\frac{3.1\times a^3\times b^3}{a^2+b^2}$			$d^4=1.18\ h^4$
		$S=\frac{20\times T}{b^3}$	$S=\frac{4.8\times T}{b^3}$	$S=\frac{(15\times a+9\times b)\times T}{5\times a^2\times b^2}$			$S=\frac{5.3\times T}{h^3}$
	homogeneous form	$T=\frac{\theta\times G}{l}\times.0216\times b^4$	$T=\frac{\theta\times G}{l}\times.140\times b^4$	$T=\frac{\theta\times G}{l}\times.820\times b^4$	$T=\frac{\theta\times G}{l}\times3.069\times b^4$	$T=\frac{\theta\times G}{l}\times6.184\times b$	$T=\frac{\theta\times G}{l}\times\frac{h^4}{8.648}$
		$\theta=\frac{S\times l}{G}\times\frac{2.315}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.488}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.016}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.027}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.047}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.632}{h}$
SYNTHETIC FORMULAE		$T=\frac{\theta\times G}{l}\times.0216\times b^4$	$T=\frac{\theta\times G}{l}\times.141\times b^4$	$T=\frac{\theta\times G}{l}\times.81\times b^4$	$T=\frac{\theta\times G}{l}\times3.069\times b^4$	$T=\frac{\theta\times G}{l}\times6.24\times b^4$	$T=\frac{\theta\times G}{l}\times\frac{h^4}{8.678}$
		$\theta=\frac{S\times l}{G}\times\frac{2.313}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.481}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.015}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.024}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.039}{b}$	$\theta=\frac{S\times l}{G}\times\frac{1.600}{h}$
RELATIVE RIGIDITY torque related to equivalent circular section		72.38%	88.59%	56.55%	19.28%	9.80%	96.54%
RELATIVE FLEXIBILITY angle of twist related to equivalent circular section		85.87%	83.56%	99.19%	182.69%	262.15%	84.01%
RELATIVE RESILIENCE strain energy related to equivalent circular section		62.15%	74.03%	56.09%	35.22%	25.69%	81.10%

Gears
Spur Gears
are available up to 17 feet diameter and 35 inch face. Large mill gears are a Hamilton Gear specialty.
Internal Gears,
generated to 36 inch pitch diameter and formed-cut to 8 feet pitch diameter.
Bevel Gears
can be made from any suitable gear material in sizes up to 62 inches diameter and any pitch.
Helical Gears,
available in sizes up to 17 feet diameter, with any helix angle desired.
Herringbone Gears
are produced in sizes up to 48 inch diameter with closed apex, and up to 17 feet with gap.
Worms and Wormgears.
Hamilton Gear is equipped to hob wormgears up to 17 feet diameter. Worms available up to 14½ inch diameter.
Racks of Standard Pitch
are produced in normal lengths up to 25 feet, special lengths up to 45 feet.
Helical Gear Reducers
are made in single, double and triple reductions; and in ratios up to 833 to 1 and powers to 1500 H.P. Speed increasers are also available.
Wormgear Speed Reducers
are available in single and double reductions; in ratios from 3⅝ to 1 to 6000 to 1.
Flexible Couplings
can be supplied in pin-and-rubber buffers, and semi-universal Oldham types in all sizes.

Hamilton Gear's
unique production facilities and
superior craftsmanship
are your guarantee of better
quality and faster delivery on
any industrial gear order.

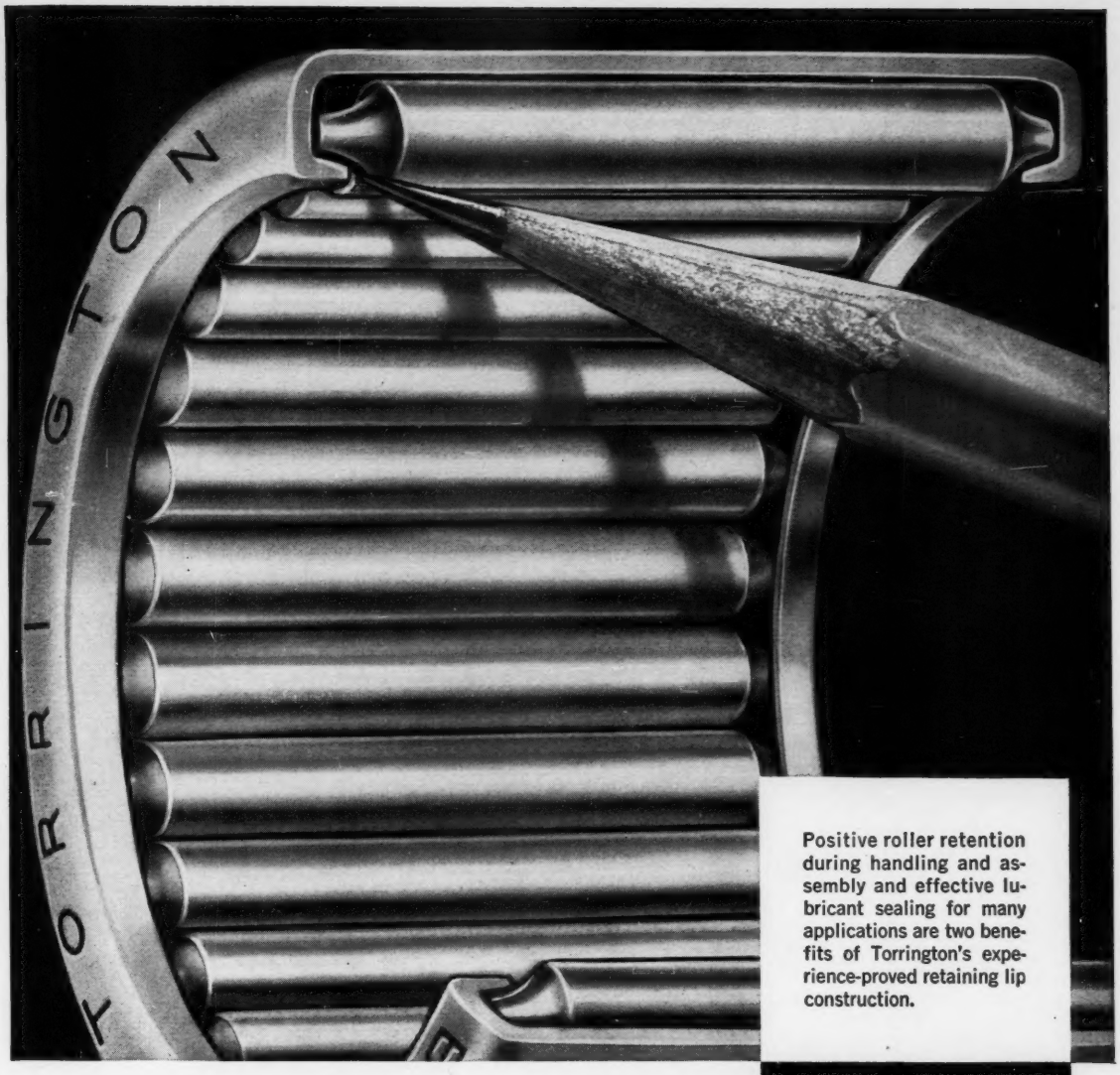
Hamilton Gear
and Machine Co., Limited.

950-990 DUPONT ST., TORONTO 4

Spur Gears *Helical Gears* *Herringbone Gears* *Bevel Gears*

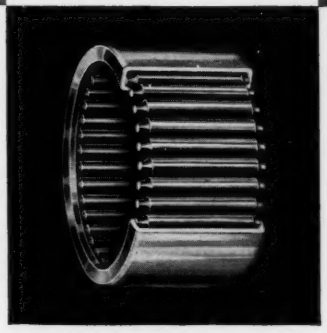
In all sizes for every industrial application— *Wormgears* *Spiral Gears* *Speed Reducers* HGC-153

Circle number 141 on time saver card



Positive roller retention during handling and assembly and effective lubricant sealing for many applications are two benefits of Torrington's experience-proved retaining lip construction.

This little lip makes a big difference!



The turned-in lip at each end of Torrington Needle Bearings positively retains the trunnion - end rollers and makes the bearing truly a complete unit, with no possibility of roller fall-out.

This unit construction simplifies installation and servicing. The closely controlled clearance and the large area between cup lips and shaft form an effective labyrinth seal. Also this retaining lip allows pregreasing the bearing with the proper lubricant for each application.

Long experience with the Torrington Needle Bearing in thousands of applications has proved the merit of this and other features in efficient performance and long service life. Make sure *your* product benefits from the best that experience has to offer—specify Torrington Needle Bearings.

TORRINGTON BEARINGS

District Offices and Distributors in Principal Cities of United States and Canada

The Torrington Company Limited, 925 Millwood Rd., Toronto 17, Ont.

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • NEEDLE ROLLERS • BALL • THRUST

Circle number 138 on time saver card

Compressor springs: the Herringbone and the Gimbal

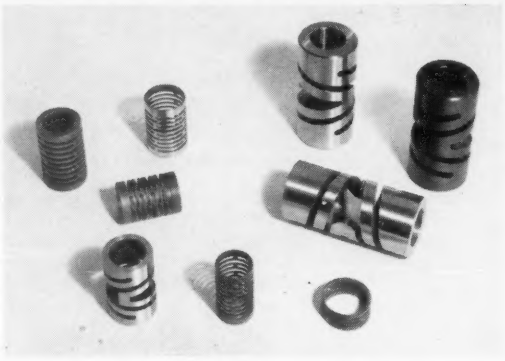
Consolidated Controls Corp. (a subsidiary of Consolidated Diesel Electric Corporation) have developed a line of precision compression springs to be used where conventional springs are not suitable.

Designed to meet the requirements of instrument and control designers, the springs fall into two classes: the Herringbone and the Gimbal.

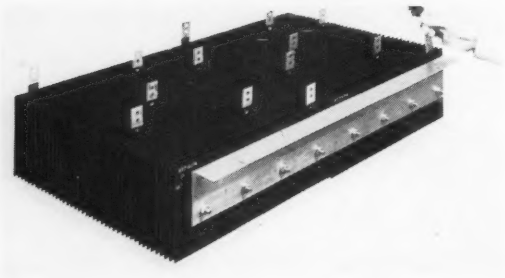
Both are machined, heat-treated, and precisely ground to give perfectly square ends, a tight control of free length, and an exact matching of specified spring rate.

The units are constructed to eliminate completely the twist (between the end faces) that can produce shifts. Another advantage of the new design, over a coil spring, is the uniformity of spring rate from zero up, since the effective length of turn does not change with load. Finally, the symmetric application of force output at points diametrically opposite, eliminates any tendency to cock. (214)

The Herringbone design is the more difficult to manufacture, but, for the same characteristics, occupies less volume than the Gimbal.



Selenium stacks: half size and double rating



Canadian designed high current density (HCD) selenium rectifier plates in a complete size range have been announced by Canadian Line Materials Limited.

They are manufactured using new techniques, including vacuum deposition of the selenium. The company states that these HCD stacks can be continuously operated at twice NEMA ratings, with only a slight temperature rise of 15 to 20 deg C, which allows many years life expectancy. The physical size of these selenium stacks is just half those previously offered at NEMA ratings. A reverse voltage of 26 volts RMS is standard, but 33 volt plates are available. (215)

Tool steel: helps save lost stitches

When The New Jersey Wire Stitching Machine Company brought out a faster model of their carton stitcher, they began having trouble with part failure.

The parts that were failing were a clutch ring, bender bar and former, and a clutch ratchet. These were redesigned in tool steel and field tested to give an increase of over 300% in the life of the parts.

The clutch ring is now made of cold-drawn Sagamore steel (made by Allegheny Ludlum Steel Corporation) hardened and drawn to Rockwell C 59-60. A clutch ratchet, which operates within this assembly, is made from centreless ground Seminole hard steel, hardened to Rockwell C 57-58.

The bender bar and former is made of cold drawn Sagamore, hardened to Rockwell C 60-61. The anvil and supporter, which slides on the bender and former bar is made of cold drawn Atlas 93 hardened to Rockwell C 54-55. (216)

(Continued on page 56)

Briefs

We note with interest . . .

of a new casting technique for titanium that allows valve bodies, centrifugal pumps (for example) to be cast in a rammed graphite mold composition developed by Du Pont . . . . . .

Letter from London, England, tells us that the new Clean Air Act is helping clean up fog by banning use of "dirty" fuel in large areas, Battle to keep Britain's air clean has been going on since 1273 when first such law ("no burning coal in London") was passed . . . . . .

There's even a clean-up-as-you-go movement underfoot for rock drillers now that Canadian Ingersoll-Rand has made a rock drill that sucks dust and cuttings away from the working area. We never could imagine a husky driller using a feather mop and dustpan . . . . . .

Major tenant in Big Bill Zeckendorf's 42-story aluminum and glass cruciform building in Montreal's Place Ville-Marie is appropriately the Aluminum Co. of Canada . . . . . .

Science and engineering are two most popular courses being studied under Union Carbide Fellowships. Over 60 students received grants and 19 Canadian universities participated in the plan . . .

Proceedings of 14th annual meeting of Metal Power Association is now available in printed form and comprises 16 papers . . . . . .

Relief is indicated for some common plating problems, we understand. Low sludge anodes allow recessed surfaces to be nickel plated easier and cheaper say the Hanson-Van Winkle-Munning Co. . . .

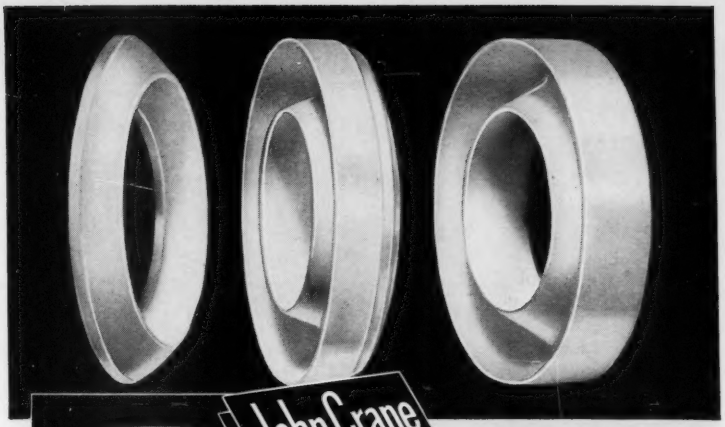
Interested in seeing a color film produced by the Pigment and Chemical Co.? They are prepared to show "Rustodian" to groups in Montreal, Toronto and Vancouver . . . . . .

Another fourteen on the calendar is the 14th annual technical and management conference of the Reinforced Plastics Division (Society of the Plastics Industry Inc.). It's being held at the Edgewater Beach Hotel, Chicago, Feb. 3-5 . . .

Plastic foam comes to Dunnville, Ont., and with it increased local prosperity. The Hamburg, Germany, president of Pekoba Plastic Foam in buying three acres of township land for the establishment of a Canadian plant, said he was "very impressed" with the way he was received by officials . . . . . .

No more candles with the automatic emergency light we've just heard about. When the power goes off—the 40,000 candlepower light turns on. It could be a lifesaver in hospitals, industrial plants and transportation terminals . . . .

(Continued on page 57)

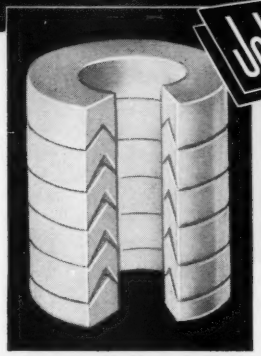


John Crane

CHEMLON *

C-V RINGS

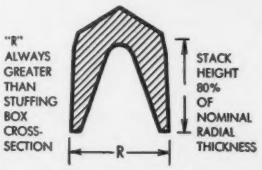
ARE INDUSTRY'S MOST UNIVERSAL PACKING . . .



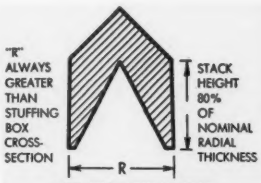
Countless successful applications of C-V Rings under the most severe service conditions have made this the closest approach to a universal packing.

It will effectively handle all industrial acids, alkalis, solvents, organic and hydraulic fluids . . . temperatures from −120°F. to +500°F. . . . is equally suited to valves, pumps, mixers, hydraulic cylinders and like equipment.

"John Crane" C-V Rings have extremely low coefficient of friction. "Breakout" friction is only slightly higher than running friction.



C-VU RING CONSTRUCTION



C-VH RING CONSTRUCTION

TWO STYLES ARE AVAILABLE:

C-VU RINGS ***for low pressure service*** —such as control and regulator valves handling gases and fluids, where it is necessary to have a very sensitive and resilient type packing.

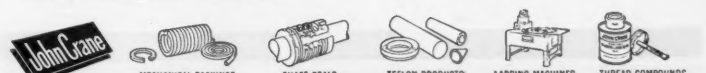
C-VH RINGS ***for high pressure service*** —for use in pumps, hydraulic cylinders and like services at pressures ranging to 500 psi. and over. These rings are constructed with a heavy wall heel to withstand pressure requirements. They are designed to provide voids between rings, so that as the Teflon expands due to heat, this take-up room minimizes any excess friction in the stuffing box.

"John Crane" C-V Rings are available in full line of standard sizes and male and female adaptors. Sizes can be molded to stuffing box specifications.

Request Bulletin P-325.

*"John Crane" C-V Rings are made from Chemlon—*the best in DuPont Teflon.*

Crane Packing Company, Ltd., Box 134, Station C, Dept. AMP, Hamilton, Ontario.



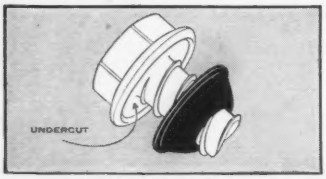
CRANE PACKING COMPANY, LTD.

Circle number 113 on time saver card

News about NEOPRENE

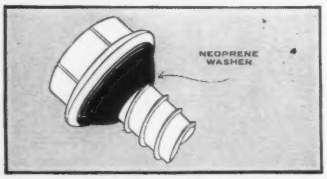
NEOPRENE washers are integral part of leakproof, cushioned fastener

A combination of an undercut head design and a conically shaped neoprene washer gives special advantages to these fasteners.



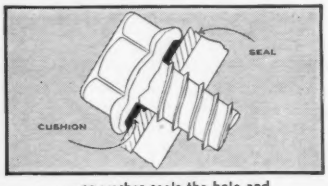
Undercut of fastener head . . .

The washer cushions the head and prevents metal-to-metal contact. Finishes are protected; transmission of vibration noise and squeaks is reduced.



. . . confines and controls flow of conical neoprene washer

As the fastener is secured, the undercut head confines and controls the spread of the resilient neoprene washer, which, in turn, flows into the top threads and seals the fastener hole.



. . . so washer seals the hole and cushions the fastener head.

It's another example of good design made possible with a part made of neoprene—the Du Pont synthetic rubber that is used throughout the automotive industry for resistance to oil, ozone and weather. Just clip the coupon for more information.

Lineman's blankets of HYPALON* take 15,000-volt shock for 147 test hours without damage

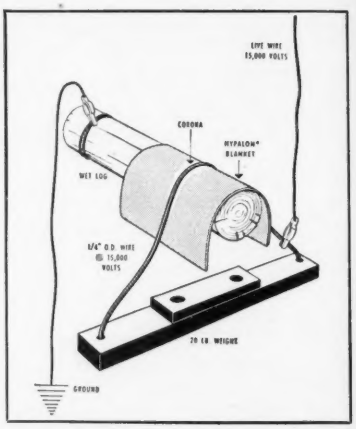
HYPALON retained full insulating value in test that burned through ordinary rubber in 12 minutes

Telephone poles often carry power lines in addition to telephone wires. When a pole needs replacement, telephone linemen usually do the job if power line voltage doesn't exceed 15,000 volts. In jockeying a new pole into position it may brush against the power wires. If the pole is wet it is conductive enough to be dangerous. Wet or not, linemen protect themselves against possible electrocution by wrapping the top of the pole with insulating rubber blankets.

Natural rubber blankets have high insulating value, but are vulnerable to corona cutting and deterioration from sunlight and weather. At the first sign of a cut or burn they must be discarded.

The extraordinary resistance of HYPALON synthetic rubber to ozone, sunlight and other oxidizing agents suggested its use for linemen's blankets to engineers at Bell Telephone Laboratories in Murray Hill, N. J.

Test blanket of HYPALON showed no damage after 15,000-volt test simulating actual service conditions. Test was discontinued after 147 hours.



Bell engineers devised a test closely simulating actual service conditions (see sketch). They soaked a pole stub in water, grounded it, draped a blanket over it, pressed a ¼-in. copper conductor against the blanket and applied 15,000 volts. Resultant arcing produced constant corona and evolved strong ozone. Ordinary rubber blankets failed quickly . . . some in 12 minutes. But a blanket of 100% HYPALON withstood 147 test hours with no corona cuts, ozone cracks or burn-throughs. Longer testing was considered unnecessary.

Performance like this makes HYPALON an excellent choice for parts or products subject to ozone, corona or strong oxidizing conditions. Mail the coupon for details on how this Du Pont synthetic rubber can help you in designing new products and improving old ones.

***HYPALON** *is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.)*

ELASTOMERS IN ACTION HYPALON® • NEOPRENE

DU PONT CANADA

Better Things for Better Living . . . through Chemistry

☐ I am particularly interested in _____

☐ Send me a free copy of *The Du Pont Elastomers* (a review of properties of neoprene and HYPALON).

☐ Add my name to the free mailing list of the *Elastomers Notebook* (contains articles based on uses of Du Pont elastomers in industry).

Du Pont of Canada Limited,
Room 400,
85 Eglinton Avenue East,
Toronto, Ontario.

Name _____

Firm _____

Address _____

City _____ Prov. _____

Circle number 143 on time saver card

Briefs *(Continued from page 55)*

Over in Blighty they (this time the Association of British Chambers of Commerce) are trying to persuade the government to switch to a decimal system for weights, measures and coinage. It'll be a hard day for music-hall comedians, playwrights and songwriters who lean heavily on (and get lots of) currency for inspiration . . . . . .

Did you know that Type 4340 alloy steel is an alloy which for nearly 30 years has been preferred for aircraft and other parts requiring metal of the highest quality? . . . . . .

E. W. Leaver of Electronic Associates writes to tell us that the liquid level apparatus described on page 42 of May 1958 DE has been used by them for a number of years . . . . . .

If you want to bone up on welding—an information centre has been formed by the American Welding Society. The centre will act as an authoritative source for all information relating to welding . . . . . .

Three-day forum of the Porcelain Enamel Institute's 20 h annual affair held at the University of Illinois in November was "Modern Practices in Porcelain Enameling" and was well attended . . . .

Without so much as a word to anyone, nylon and asbestos went and got married. The result (contrary to all accepted procedures) is a new material that conducts 25% less heat from surface to interior than the most effective material tested, say Taylor Fibre . . . . . .

Cost conscious engineers specified what is reported to be Canada's first overhead aluminum traffic sign support on Toronto's new Lakeshore Road . . . . .

Bright news is just around the corner for daytime tv addicts. A tv screen being developed by U. S. Naval Research Laboratory permits viewing of tv in bright daylight with little loss of contrast . . .

As her part of completing a world magnetic survey, Canada recently chartered a B-17 Flying Fortress to undertake a 42,000-mile survey of the Pacific . . .

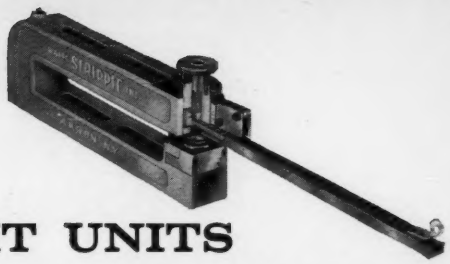
And another success for the ersatz boys is a recent announcement of a process for the manufacture of reconstituted synthetic mica sheet . . . . . .

We note that Meadows engines are now being marketed in Canada by Consolidated Diesel . . . . . .

DE's December 1958 Reports pages showed a photograph of a moon explorer's house: we now hear that chemically coated plastic may light it. Canadian engineers have made a working model of a lunar power station . . . . . .

Oh how we love the designer of silent gear materials for automobiles — our house is on the training route for a driving school . . . . . .

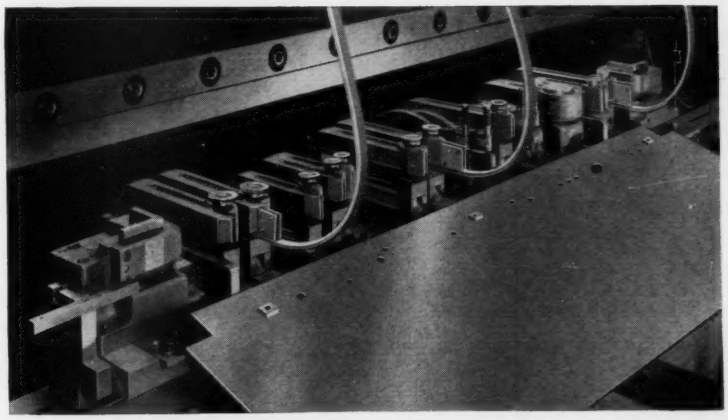
(Continued on page 58)



NEW

STRIPPIT UNITS

. . . stake nuts permanently with every press stroke!



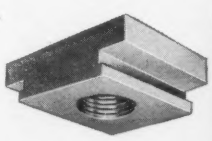
STRIPPIT PIERCE NUT UNITS save operations, time and money in assembly panel production with single-stroke insertion of Fabristeel Multipierce Nuts* into sheet metal up to .125″ thick.

Permanent Fastening by an Exclusive New Process—as nut pierces stock, metal flows into nut shoulder slot, becoming an integral part of the stock.

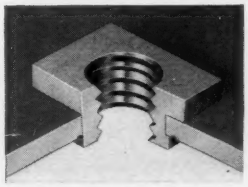
High-Speed—fast press setups, automatic feed of nuts to units for long, medium or short runs gets maximum production per press.

Flexibility—Pierce Nut Units can be quickly press-mounted in any desired pattern, changed on short notice, re-used over and over.

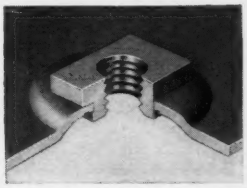
*A Product of Fabristeel Products, Inc.



Each nut is its own punch, a new one each time



Die button causes material to flow into nut slot



Simultaneous embossing for flush fastening

WRITE FOR DEMONSTRATION on your press! The speed and simplicity of Strippit Pierce Nut operation has to be seen to be believed. Also request new catalog for complete specifications.

BUY CANADIAN

STRIPPIT

TOOL & MACHINE COMPANY

A Division of Provincial Engineering Ltd.

UNIT OF HOUDAILLE INDUSTRIES, INC.

103 Hansen Road • • Brampton, Ontario

Circle number 135 on time saver card

Do YOU Have a Power Transmission PROBLEM?

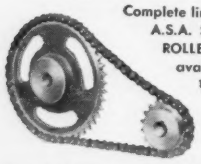
No. 25 Actual Size
Pitch 1/4" Width 1/8"

No. 35 Actual Size
Pitch 3/8" Width 3/16"

No. 41 Actual Size
Pitch 1/2" Width 1/4"

No. 40 Actual Size
Pitch 1/2" Width 5/16"

No. 50 Actual Size
Pitch 5/8" Width 3/8"



Complete line of A.S.A. STANDARD ROLLER CHAINS available from 1/4" to 2½" Pitch

Complete line of stock bore, steel and cast iron single sprockets, cast iron hub sprockets and all steel split or solid hub sprockets available; also large selection of finished bore sprockets.

Acme Roller Chain Drives are inherently dependable for efficient and economical transmission of power. In contrast with other types of power transmission media, roller chain drives have the following advantages.

POSITIVENESS

The driven sprocket turns at a speed that is exactly proportionate to the speed of the driver sprocket. They operate without slippage or creep, and are unaffected by most atmospheric conditions.

EFFICIENCY

Acme Chain Drives deliver over 98% of the power furnished by the driving sprocket to the driven sprocket. There is practically no loss in the ratio of energy between driving and driven members. Compare this efficiency with other types of power transmissions.

ECONOMY

The initial cost of Acme Chain Drives is comparable and in many instances less than other types of power transmission and life expectancy is longer.

Power consumption is less when you use ACME ROLLER CHAINS. When necessary, repairs can be quickly effected with standard repair parts.

Be sure you ask for ACME Roller Chains. Available nationally through your local Industrial Distributor.

Write Dept. 20-C for new 100-page illustrated catalog, including new engineering section showing 36 methods of chain adjustments.

Call ACME for Service

Acme Chain Corporation
HOLYOKE MASSACHUSETTS

COMPLETE LINE OF ROLLER CHAINS AND SPROCKETS • DOUBLE PITCH CONVEYOR CHAINS • STAINLESS STEEL CHAINS • CABLE CHAINS • FLEXIBLE COUPLINGS • STANDARD AND SPECIAL ATTACHMENTS

Circle number 101 on time saver card

Briefs *(Continued from page 57)*

Please hold on to your hats for the next one—"a dual stereophonic high fidelity preamplifier with high sensitivity, low hum and noise, high channel separation and individual switching for each channel to select phono or tape input is now available." . . . we didn't buy one for Christmas in case it bit the baby . . .

Our November 1958 New Products pages told about nickel-cadmium storage batteries. We now learn that one of the States' chief airlines is making the switch to this type of battery—and expect to save $50,000 a year in maintenance . .

The Australian Government has named three physical features on the Antarctic Continent in honor of the DHC2 Beaver aircraft because of the aircraft's remarkable and versatile record in operations.

Loads of up to 20,000 lb per shelf can be handled by a boltless rapid rack storage unit manufactured in Hamilton, Ont. . . . . .

Announcement of removable plastic coatings for temporary protection of highly finished surfaces set us to wondering what happened to the hundreds of Liberty ships "cocooned on the Hudson" for so many years . . . . .

The thinner tv sets tends to revive our idea of fabricating tv walls you can buy with a new house much the same as choosing the color of tiles and decorating

February 2-27—at Ottawa's Design Centre a display of British consumer goods. Lots of items new to Canadian market will include "Kitten" catamaran that can be carried on auto roof. . . . . .

Brief Talepiece—snorers in English hospitals are to get specially designed beds. They disturb other patients so much doctors tried putting them all in the same ward. There was so much noise nobody got any sleep! Research showed that most snorers hit their peak on their back. New bed just won't let them do that—they have to sleep on their side. ★

NEXT MONTH

Design Engineering

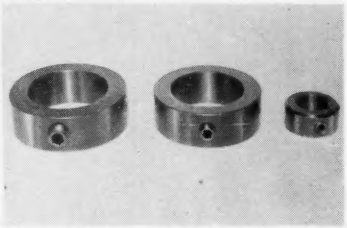
Features

More

CANADIAN DESIGNS

New products & materials

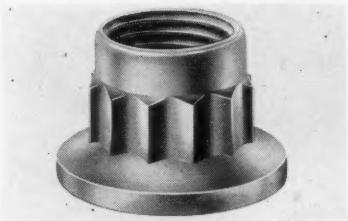
Alloy steel studs



Jergens Tool Specialty Co. has brought out this new line of double-drawn and heat-treated alloy steel studs. They are designed to prevent thread distortion and stud failure. Used principally in tool and die work for machine and fixture set-up, they have a tensile strength of over 125,000 psi. They are now available in quarter-inch multiple lengths up to 12 in. long and in diameters of ¼, 5/16, ⅜, ½, 5/8, ¾, ⅞ and 1 in. (220)

High tensile nuts

The new series of self-locking nuts announced by the **Elastic Stop Nut Corp.** have been designed for high tensile bolting requirements. They consistently develop the full fatigue strength of 220,000 psi bolts yet are from 10 to 33% lighter, size for size, than the lightest 180,000 psi locknut. Further weight saving is made possible by the reduction of the wrench clearance requirements which permits smaller structural components. Airframes and missiles designed to operate at supersonic speeds will require the performance characteristics that these high-tensile nuts offer. (221)

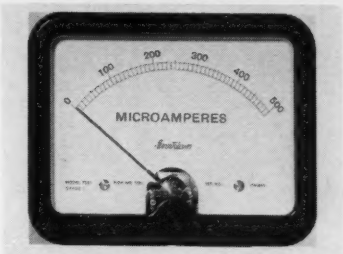


Plastic laminate

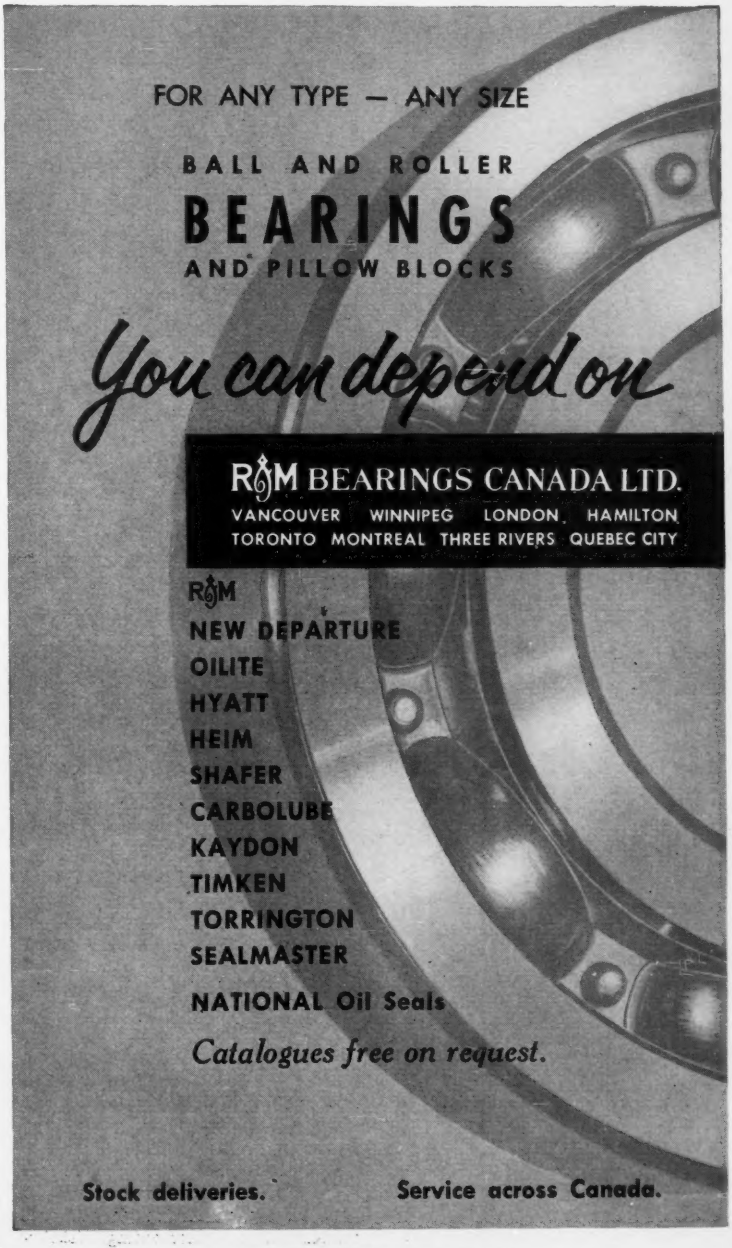
A laminated plastic with strength retention after high temperature exposure is available from **National Fibre Co.** It is constructed from glass fabric combined with a special high temperature resisting phenolic resin. More than 95% strength is retained after ½ hr exposure at 500 deg F. Higher temperatures can be withstood for shorter time periods. The material is available in sheet sizes of 39 in. sq. and 39 in. by 47 in. and in a thickness range from 1/16 to ½ in. Its color is dark brown; its finish, semi-gloss. (222)

Rectangular meter

A new rectangular meter in three sizes features an increased scale length and flattened arc for easier and more accurate reading. Ranges and types of movement are the same in this series as in the established square pattern instruments and certain round models. The mounting



(Continued on page 60)

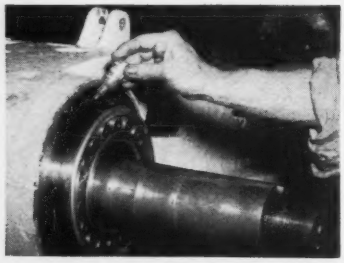


Circle number 142 on time saver card

NO PRESS FIT NEEDED WITH LOCTITE SEALANT

"We replace 9" bearings in less than an hour— and save $155 each!"

Says David B. Cook, President
Acme Road Machinery Co., Inc.
Frankfort, New York



"Replacing 9-inch bearings in the jaws of a giant rock crusher once required days to bore the housing and build up weld metal for reboring to a .0015" interference fit. Even then, placing the bearing took two men 3 or 4 hours.

Now, thanks to LOCTITE Liquid Sealant, we prepare the housing, clean and insert the bearing with a slip fit in less than one hour! Crusher jaw bearings locked in with LOCTITE have been in rugged service for many months without report of a single failure."

You, too, can eliminate interference fits. LOCTITE hardens between bearing and housing to form a bond that exceeds any interference fit . . . requires no heat or mixing.

Write for further information on money-saving LOCTITE applications in production or service . . . for slip fitting bearings, bushings, hardened sleeves and rotors on shafts; for locking threaded fasteners or studs securely; for sealing against high-pressure fluids.

LOCTITE® SEALANT

AMERICAN SEALANTS COMPANY

601 Woodbine St., Hartford 6, Conn.

J. S. Parkes Co., Ltd., 220 St. Paul St., West Montreal, P.Q.

Circle number 102 on time saver card

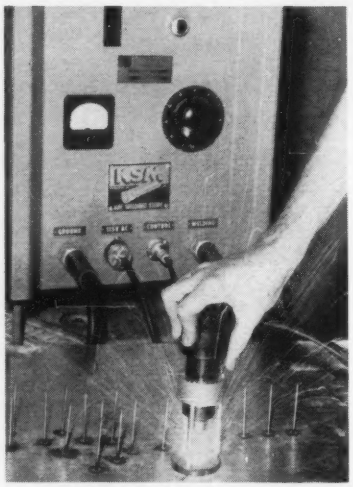
New products

(Continued from page 59)

centres have also been duplicated to make the rectangular patterns interchangeable with their square or round counterparts. These three models measure 2⅞ x 2¼ in., 4⅛ x 3 3/16 in., and 5⅞ x 4⅜ in. respectively. They are manufactured by **Ernest Turner Electrical Instruments Ltd.** (223)

Percussive welder

Studs and fasteners can be welded to light gauge metals with this percussive welding unit. It operates on a stored



energy principle which discharges current and end welds in 0.006ths of a second. It will weld to ferrous and non-ferrous metals in diameters up to 3/16 in. Stainless steel, coated or enameled sheet do not show distortion or discoloration. A small 2½ lb portable hand tool holds the stud and closes the circuit allowing the current to be discharged when it is placed against the work surface. It operates from either 115V/230V, single phase, 60 cycle ac. The power unit weighs 144 lb and has 4 in. diameter wheels for portability. It is introduced by **K S M Products, Inc.** (224)

File system

Exclusive sales rights to the Pack Interlock Filling System including the complete line of Roll Drawing Files have been acquired by the **Hamilton Manufacturing Co.** The filing system consists of individual 2½-in. square containers, easily dovetailed together to form any size or shape stack required. The inner tubular receptacles accommodate drawings up to 2¼ in. in diameter and are available in six lengths ranging from 22 to 54 in. Hamilton Pack files can be stacked from floor to ceiling, around pipes or ducts, under tables or in virtually any available space. The large stick-on labels in six colors provide unlimited combinations for color coding. (225) ★

BLOOD BROTHERS

Universal Joints offered by ROCKWELL-STANDARD for almost any application

Sizes and types for heavy-duty automotive, construction and road building machines, farm implements, tractors and industrial machinery

SAVE YOUR ENGINEERING TIME

At Rockwell-Standard, you can select from a wide range of universal joints and complete drive assemblies. Torque capacities range from 350 to 500,000 inch lbs.—lengths from very close-coupled industrial joints to assemblies 120" overall.

You can be confident they are produced in a modern plant, tooled for precision manufacturing. And you can rely on their high reputation for dependability.

When you specify Blood Brothers Universals, you can save valuable engineering time by stating your problem to our service-minded engineers. They're cooperative, friendly and long-experienced. Just write or call.

WRITE FOR BULLETIN 557 . . .
and for your convenience in specifying, request our free Blank Form "Specification Sheets".

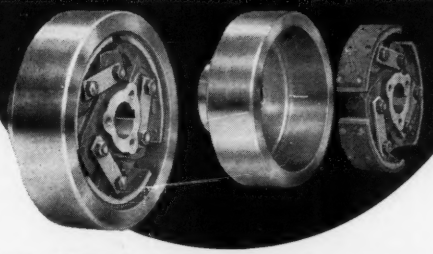
ROCKWELL-STANDARD CORPORATION
BLOOD BROTHERS UNIVERSAL JOINTS
ALLEGAN, MICHIGAN

UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES

Circle number 129 on time saver card

Flexible ACTION IN THE *New* HILLIARD TWIFLEX

AUTOMATIC CENTRIFUGAL CLUTCH COUPLING



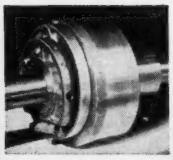
11 NEW IMPORTANT FEATURES . .

1. Flexible in all directions.
2. Absorbs Shock.
3. Limits torsional vibration.
4. Has adjustable idle speed
5. Can be furnished in automatic free-wheeling type.
6. Smooth starting.
7. No slip under normal load at full speed.
8. Protects driver and driven mechanisms against overload shock.
9. Can be furnished in automatic backstop type.
10. Prevents torsional resonance.
11. Easily assembled even in blind installations.

If you have problems of misalignment - smooth starting - vibration - overload - or assembly in the manufacture or operation of:

- Compressors
- Blowers
- Diesel Engines
- Excavators
- Refrigeration
- Hammer Mills
- Textile Machinery
- Wire Machines
- Fans
- Gasoline Engines
- Back Stop Brakes
- Mixers
- Conveyors
- Pumps
- Electric Motors
- Generators
- High Speed Pulverizers
- Tube Mills

- Let Our Engineers Consider Your Problem. Twiflex May Be The Answer.



SINGLE REVOLUTION CLUTCH

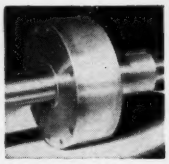
For automatic, accurate control, electrically or mechanically, of intermittent motion, indexing, cycling, cut-off.

Write for Bulletin 239.

OVER-RUNNING CLUTCH

For automatic engagement and release on two speed drives, dual drives and for ratchet feed or backstop action.

Write for Bulletin 231.



SLIP CLUTCH

For overload protection — constant torque — constant tension on reeling or winding stands.

Write for Bulletin 300.

WRITE TODAY!

For Details of TWIFLEX Coupling in Catalog CE-3

IN CANADA: UPTON BRADEEN-JAMES LTD.
890 Yonge St. - TORONTO • 8760 Verville St. - MONTREAL

THE HILLIARD CORPORATION

30 W. FOURTH ST. — ELMIRA, N. Y.

MANUFACTURING CLUTCHES FOR 50 YEARS

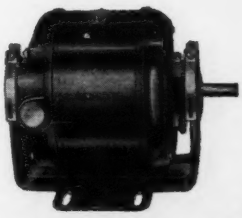
What do YOU want in a MOTOR?

✓ DEPENDABILITY... R&M has it
✓ QUIETNESS ..... R&M has it
✓ LIGHTNESS..... R&M has it
✓ PERFORMANCE... R&M has it
✓ RANGE ..... R&M has it
and MORE ..... R&M offers a motor especially designed to get top performance from your equipment. Motors of the right size, speed, frame and torque characteristics to fit your exact requirements.

The simplest, most convenient single phase motor on the market!

Low first cost, reliability of performance and simple maintenance requirements put the R & M Split Phase motor out front! Ideally suited for propeller fan, blower fan or fan belt drive applications where low starting torques may be combined with high efficiency and low starting currents.

Specify R & M motors for top quality . . . for top performance from your equipment.



RESISTANCE SPLIT PHASE MOTOR

For complete information and prices Write today for Bulletin M-004/C7

THE ROBBINS & MYERS COMPANY
of CANADA LIMITED—BRANTFORD, ONTARIO

Fractional & Integral H.P Motors & Generators | Moyno Pumps | Propellair Industrial Ventilating Equipment | Electric Fans | Electric & Hand Hoists & Cranes

Circle number 128 on time saver card

People in the news

New president-elect of the 18,000-member Association of Professional Engineers of Ontario is **A. W. F. McQueen.** Mr. McQueen is also president of H. G.

McQueen

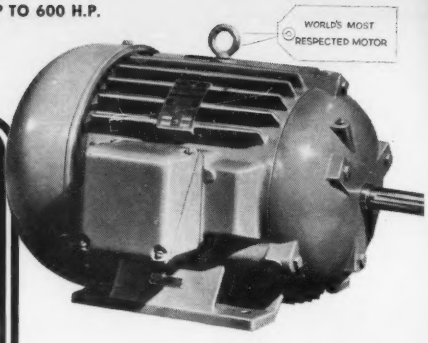
Totton

Acres & Co. of Niagara Falls, Ont.—Canada's largest firm of consulting engineers. Born in England, he came to Canada when he was twelve and graduated from University of Toronto in 1923. He now travels 35,000 miles a year as a professional engineer. Reading, woodworking and enjoying family life are his hobbies.

Voted "maths and science teacher of the year" in Ontario, **H. Edwin Totton** is head of the mathematics department of Toronto's Forest Hill Collegiate. In a telephone interview with DE Mr. Totton said "I try to teach my students maths in a way that's related to the world

(Continued on page 64)

UP TO 600 H.P.



BROOK ELECTRIC MOTORS

It's what's inside a **BROOK MOTOR** *that counts!*

One motor may look like another outside, but inside BROOK ELECTRIC MOTORS have got what it takes for maximum, trouble-free service . . . yet they cost less. Get the complete Brook story . . . learn how you can get lower cost horsepower. Write for illustrated catalogue.

Fast deliveries of all popular models.

SINCE 1904

BROOK ELECTRIC MOTORS
OF CANADA LIMITED

250 University Avenue, Toronto 1, Ontario

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Formapex will serve you well*

This versatile laminated plastic can be punched, cut or drilled. It is resilient, tough, stable and highly resistant to dilute acids and alkalis.

* In paper based electrical qualities for all rigid insulation service. In fabric based mechanical qualities as gears, pinions, bushes, bearings, jigs, collars, washers, etc.

Manufactured by
IOCO LIMITED
Anniesland, Glasgow, Scotland

Agents in Canada

Cemco Electrical Manufacturing Co. Limited
22 East Fifth Avenue, Vancouver, 10.
Cemco Switchgear Limited,
P.O. Box 550, 561 Maisonneuve Street, Granby, Quebec.

Circle number 120 on time saver card

Answers to hundreds of design problems in fastening!

The new Simmons Fastener Catalog #1257 has all the facts you need to know about the famous SPRING-LOCK, LINK-LOCK, QUICK-LOCK, ROTO-LOCK, DUAL-LOCK, and HINGE-LOCK.

44 pages of important data with complete specifications, engineering drawings, installation details, numerous applications and instructions for ordering.

***SEND TODAY** for your FREE copy*

SIMMONS FASTENERS

Quick-Lock · Spring-Lock · Roto-Lock · Link-Lock · Dual-Lock · Hinge-Lock

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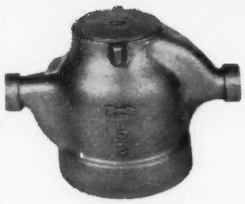
Call on 35 years experience making

TOP QUALITY CASTINGS

BRASS · BRONZE · ALUMINUM



SHELL CASTINGS and CORES . . .
made to close tolerance with a remarkably smooth finish.

HI-LEAD BRONZE BEARINGS

For personal service — phone or write:

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FORMERLY SHERRATT BRASS FOUNDRY LTD.
225 CENTRE ST. E., RICHMOND HILL, ONT. AV. 5-1021

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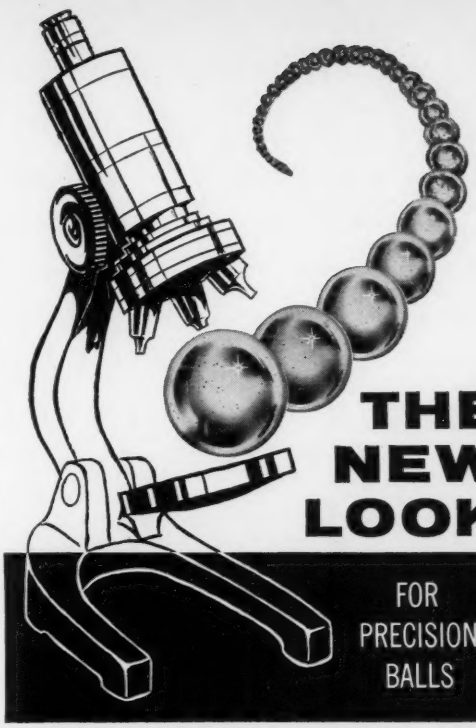

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A ball is a ball, its shape doesn't change, but modern industry demands a wider scope of materials, finer finishes and closer tolerances. Hartford's experience, facilities and continuing program of ball research and development combine to give you "the new look" to meet your new demands. The most complete catalog ever published on essential ball information (shown at the left) is yours for the asking. It's a guide to quick selection of precision balls for practically any requirement and material selection. Write for your copy today!

HARTFORD LEADS IN BALLS OF ALL MATERIALS

High Carbon Chrome Stainless Steels	Glass	Copper
K-Monel	Nylon	Beryllium Copper
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Circle number 118 on time saver card

Keeping informed

New booklets and technical data for you to read

Surface plate relapping—Bulletin 101 describes the Herman Stone Co. process for relapping granite surface plates.

Epoxy tubing — some engineering notes have been assembled (for use in encapsulation of electronic components) by the Resdel Corporation.

Dust control—the Flexaust Co. bulletin 82 is profusely illustrated with photographs showing varied applications of dust control equipment.

Roller chains—information on these and sprockets, conveyor chain attachments are now available from Acme Chain in the form of 98-page catalogue.

Printed circuits — the Institute of Printed Circuits has released a comprehensive technical manual dealing with this subject.

Slide rules — 24 pages of useful information on what to look for in the purchase of slide rules. Keuffel & Esser Co. prepared the booklet.

Plastics for electronics — a big wall chart is one of publications available from Emerson & Cuming dealing with this subject.

Ni-Resist ductile irons — new data, particularly on property of this material at elevated temperatures is available in booklet form from International Nickel Co. of Canada.

Footcandle levels — new method of determining the illumination for specific tasks now available in reprint form from the Illuminating Engineering Society.

Metal framing — Burndy of Canada booklet describes a system of continuous slot metal framing and its applications.

Welding equipment—short form type of catalogue put out by Vacuum Tube Products Co. describes equipment specially designed to join light gauge materials.

Glass fibre insulation—the range, description, features, uses and performance of this material are described in L. O. F. Glass Fibers Co. booklet WPD-13.

Low alloy steel electrodes — experts made a prolonged study of this field and publish their findings in a specification prepared jointly by American Welding Society and American Society for Testing Metals.

Dry batteries — Burgess Battery Co. have published a 100-page manual—"Complete data on dry batteries for the design engineer."

Cemented carbides for industry—this is title of new catalogue being distributed by Allegheny Ludlum Steel Co. It includes technical information.

Stock transformers — detailed listings of over 450 military and commercial transformers compiled by Chicago Standard Transformer Co.

Foamed Silica material—background information on this 99% pure fused silica. Folder outlines characteristics and uses: Pittsburgh Corning Corporation.

Magnetic flowmeter — the principle, operation and specifications are described in catalogue 10D1416 compiled by Fischer and Porter.

Pipe drafting — new book on the fundamentals of this subject just published by John Wiley and Sons Inc. It is primarily for use of students.

University support—just published is the current report of the National Research Council of Canada on university support for science, engineering and medicine for the 1958-59 year.

Adhesives—use of dental cement for mounting instruments on test specimens is described in Vibration Notebook, October 1958 issue, put out by MB Manufacturing Company.

750/1,000-kw gas turbine—illustrated details of operating experience; design features; fuels and applications are discussed in new Clark Bros. bulletin 167.

Electro-hydraulic servo systems — four bulletins describe many new additions in the components field of this type of fluid power system: Oilgear Co.

Machining glass base laminated plastics — information is available from National Fibre Co. of Canada regarding techniques.

Engineering careers in Canada—the 1958-59 edition of this work is divided into 20 sections each listing a resume of the particular field of engineering. It is published by the Engineering Institute of Canada.

Belt idler—Jeffrey Manufacturing Co. have published an eight-page brochure listing various types of installations.

Metal laminate—information in the form of brochure tells about physical and chemical properties of vinyl plastic sheeting bonded to steel, aluminum and magnesium. O'Sullivan Rubber Company are publishers. ★

People in the news

(Continued from page 62)

around them. There must be a rapport between teacher and student before you can teach them anything that they're likely to retain." We detected an unusual enthusiasm in Mr. Totton's own attitude toward teaching. And one that appears not to have been diminished by more than 25 years' experience.

A graduate of mechanical engineering of the University of Toronto, **B. C. J. (Bud) Sinclair** has been appointed to the sales staff of Computing Devices of Canada Ltd. Since graduation he has had diversified experience in several engineering fields. Mr. Sinclair is a member of the Association of Professional Engineers of Ontario, and Society of Automotive Engineers. He holds a commercial pilot's license.

Sinclair

Wilkins

In his new position as assistant to the president, **R. E. Wilkins,** O.B.E., will be responsible for developing new projects. Mr. Wilkins was formerly superintendent of civil engineering design for the same company (B.C. Engineering). A graduate of the Royal Military College and Queen's University, Mr. Wilkins is president of the Association of Professional Engineers of British Columbia, and the Military Engineers Association of Canada.

W. H. Brokenshire has been appointed to the staff of the Canadian Development and Research Division of the International Nickel Co. of Canada.

Dr. E. J. Buckler has been appointed vp Research and Development of Polymer Corporation Ltd. Dr. Buckler is the author of many papers which he has presented at technical conferences in Europe and America.

W. A. (Bill) Wood—to director of marketing for Central and Western Ontario Radionics Ltd. A graduate of University of Toronto, Mr. Wood has broad experience in the electronic instruments field.

J. C. Floyd—On October 9, 1958 Mr. Floyd (vp Engineering, Avro Aircraft Ltd. Canada), read a paper "The Canadian Approach to All-Weather Interceptor Development" at the 14th British Commonwealth Lecture at the Royal Institution, London, Eng.

D. C. R. Miller—January 13, 1959 at a meeting of the Toronto section of the American Society of Lubrication Engineers, Mr. Miller spoke on "Molybdenum Disulphide as a Lubricant." He is vp and general manager, Dow Corning Silicones Limited. ★

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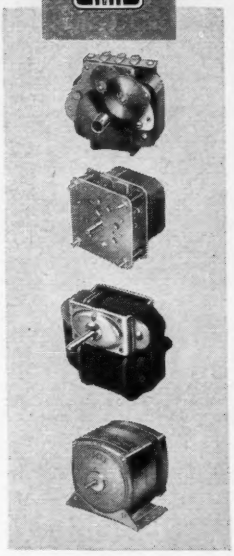

high-torque fast-reversing motors

For servo-mechanisms, remote switching and positioning devices, recording instruments, and voltage regulators. Adaptable to a variety of control circuits (including electronic) and power requirements up to 1/25 hp. Meet the specifications of many applications requiring a compact, powerful motor.

open and enclosed geared types

For longest life per dollar invested, put Barber-Colman geared motors into your product. High-quality construction throughout . . . accurately hobbed gears . . . high torque, positive starting. Wide choice of models: Unidirectional, reversible, synchronous.

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640 DeCourcelle St.
Montreal 30, Quebec

John Herring & Company Ltd.
3468 Dundas Street West
Toronto, Ontario

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FACTS YOU should know about malleable iron

FACT No. 4 . . .

It Can Be Cold Worked

Another amazing property of malleable iron is its ductility which enables malleable parts to be cold formed to exact dimensions. This can be done by straightening, coining, shearing or rolling. We have the most up-to-date machinery at the Galt Malleable Iron to perform these operations so that you can count on our malleable parts to meet close tolerances.

Malleable iron can also be punched or drifted without breaking down the composition of the material. We will be glad to discuss with you how malleable iron can help you in the design and production of fine precision parts.

SEE WHAT MALLEABLE IRON WILL DO FOR YOU.

GALT
MALLEABLE IRON
LIMITED
GALT ONTARIO

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Editorial

Wanted: more Canadian designs

Know These Interesting Canadian Designs.

We are more than pleased to be able to devote so much space in this issue to Canadian design work.

Featured are: the Caribou wing-root fittings (designed by deHavilland) and mechanical details of the undercarriage (by Jarry Hydraulics); some of the results of experience gained at the Army Development Establishment in Ottawa on fasciculated (clustered) torsion-bar spring design; intimate details of the Hoover polisher, designed and developed in Hamilton; design case histories from Cockshutt Farm Equipment Ltd., of Brantford.

Would that we were able to devote as much space as this each month to Canadian designs, but perhaps the day is not too far distant when Canadian firms will do more of their own design work so that we can do just this.

The Design Engineering Show.

The interest shown by Canadians in this Show is still almost conspicuous by its absence. Believe it or not, only two firms have taken advantage of the Government offer (see our January editorial) to consider firms that want to exhibit.

Castings Clinic.

How to cut costs in designing and processing grey iron castings is the subject of a one-day Clinic to be held in Toronto, April 28.

Sponsored by the Gray Iron Founders' Society, the Clinic will feature:

(1) design possibilities exclusive to gray and ductile iron;
(2) economies by designing-in the inherent advantages of grey iron;
(3) new services being offered by informed foundrymen; and
(4) recently developed short cuts in designing castings.

Examples will be given showing how engineers have solved typical problems with gray iron castings.

The number registering will be limited to 40.

Professionalism.

The Northern Electric Co. Ltd., recently notified its technical personnel that the title "engineer" is only recognized and assigned by the company to those registered in the Professional Engineering Association or Corporations of the province in which they are located.

This policy is in keeping with the spirit of the Professional Engineers Act. Companies that give job titles using the word "engineer" expose the individual to legal prosecution, if he is not registered as a professional. How rigid the rule is, however, we don't know, but we can't recall any action being taken.

William Morse.

Instead of writing to a dozen different manufacturers to get information and literature about products mentioned in DESIGN ENGINEERING just circle the numbers on the other side of the card below . . . complete and mail . . . We contact the manufacturers for you and pay all postage

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FEBRUARY 1959

Editorial Please send me further information on the following editorial items:

- ☐ Caribou wing is rugged yet refined
- ☐ How to measure local strain—quickly
- ☐ Farm implements need strength first
- ☐ Caribou undercarriage: a capsule type shock strut
- ☐ DE lays bare a Canadian floor polisher
- ☐ Tight space? Try fasciculated springs

New Products and Literature

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FEBRUARY 1959

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New chain has steel's strength plus nylon's wear resistance

NY-STEEL FLAT TOP CHAIN on Horix Fitting Machine with nine fitter valves. This unit is in service at Mangels Herold Company, manufacturers of King Liquid Laundry Starch.

Link-Belt Ny-Steel flat-top chain fits existing sprockets

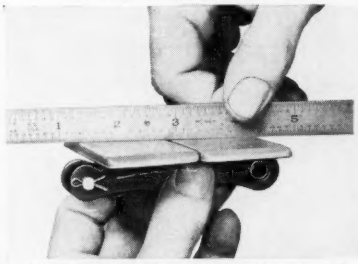
Nylon and Steel — Link-Belt combines both in Ny-Steel Flat-Top Roller Chain. This combination gives you a smooth, resilient nylon carrying surface to reduce glass breakage and track wear — plus a precision steel roller chain with the strength and durability to carry heavy loads without stretching. Ny-Steel is less than half the weight of similar all-steel chain — has proven itself ideal for safe, low-cost conveying of bottles, cans and similar items.

Exceptional wear-life

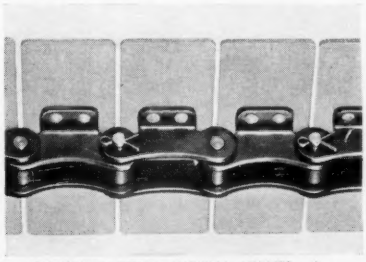
Long life is one of Ny-Steel's many outstanding features. It resists chemicals and corrosion . . . retains pitch, even under moisture conditions . . . gives long-lasting service with practically no top-plate or track wear.

Ny-Steel is easy to install . . . fits existing sprockets. And for new installations or replacements, Link-Belt makes a full line of cut-tooth sprockets. Ny-Steel comes with top plates assembled on either stainless or heat-treated carbon steel chain.

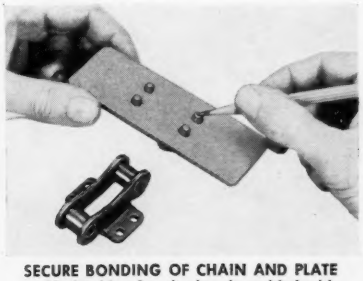
Why Ny-Steel is industry's most advanced flat-top conveyor chain



RIVET-FREE SURFACE — Top plates are of uniform thickness, without rivet pockets or projections. Each is chamfered and mounted level with adjacent plates.



PRECISION STEEL ROLLER CHAIN gives Ny-Steel its great strength . . . facilitates installations and maintenance. Can be easily coupled or uncoupled.



SECURE BONDING OF CHAIN AND PLATE — Underside of each plate is molded with projections that become self-rivets. This leaves surface free of obstructions.

The large picture above illustrates one of many applications of Ny-Steel flat-top chain. Besides being smooth, nylon plates are shock-absorbent . . . assure safe, easy transfer of containers.

Ny-Steel top plates are available in 3¼ and 4½-in. widths. Folder 2492 contains complete dimensions and specifications.

HEADQUARTERS FOR CHAINS, SPROCKETS is your nearby Link-Belt factory branch store or authorized stock-carrying distributor. Write for Catalog 900.

LINK-BELT

CHAINS AND SPROCKETS

LINK-BELT LIMITED: Scarboro Plant, General Offices and District Sales—Dept. 259-DE, Scarboro, Ont., Station H, Toronto 13 • Eastern Avenue Plant and Factory Branch Store—Toronto 8 • Sales Offices and Factory Branch Stores — Montreal 15 • Vancouver 12 • Winnipeg 16 • Swastika, Ont. • Halifax: Austen Bros. Ltd. • District Sales Offices— Edmonton • Hamilton • Sydney: Austen Bros. Ltd. • Foundry at Elmira, Ont. 14,743-C

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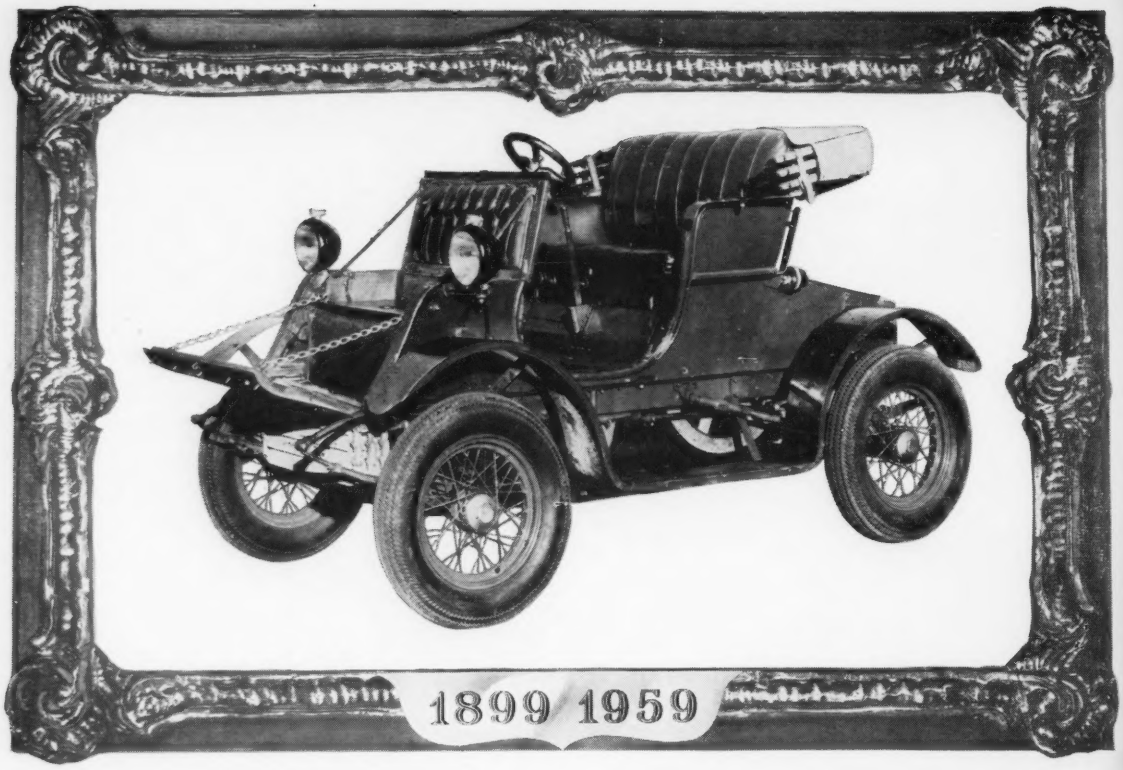

Everything's changed but the trademark on the bearings

BUILT by the St. Louis Motor Car Co. in 1899, this car was the first equipped with Timken tapered roller bearings. It's still running. And today every make of American car but one uses Timken bearings. The things that the trademark "Timken" stands for haven't changed. It still means the highest quality, the best-known name in bearings, and the kind of service you can't get anywhere else. It means better performance with longer life and less maintenance in machine tools, steel mills, heavy construction machinery, farm implements and tractors —wherever wheels and shafts turn.

"Timken"is a registered trademark that identifies all products of The Timken Roller Bearing Company—tapered roller bearings, fine alloy steel bars, seamless steel tubing and removable rock bits.

It's to your advantage to remember that"Timken"is not a type of product. It's your assurance of the best in tapered roller bearings, fine alloy steels and removable rock bits. The Timken Roller Bearing Company, Canton 6, Ohio, U. S. A. **CANADIAN PLANT:** St. Thomas, Ont. Cable: "TIMROSCO".

TAPERED ROLLER BEARINGS ○ REMOVABLE ROCK BITS ○ FINE ALLOY STEEL

TIMKEN

TRADE-MARK REG. IN CANADA AND U.S. PAT. OFF.

first in quality for 60 years

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